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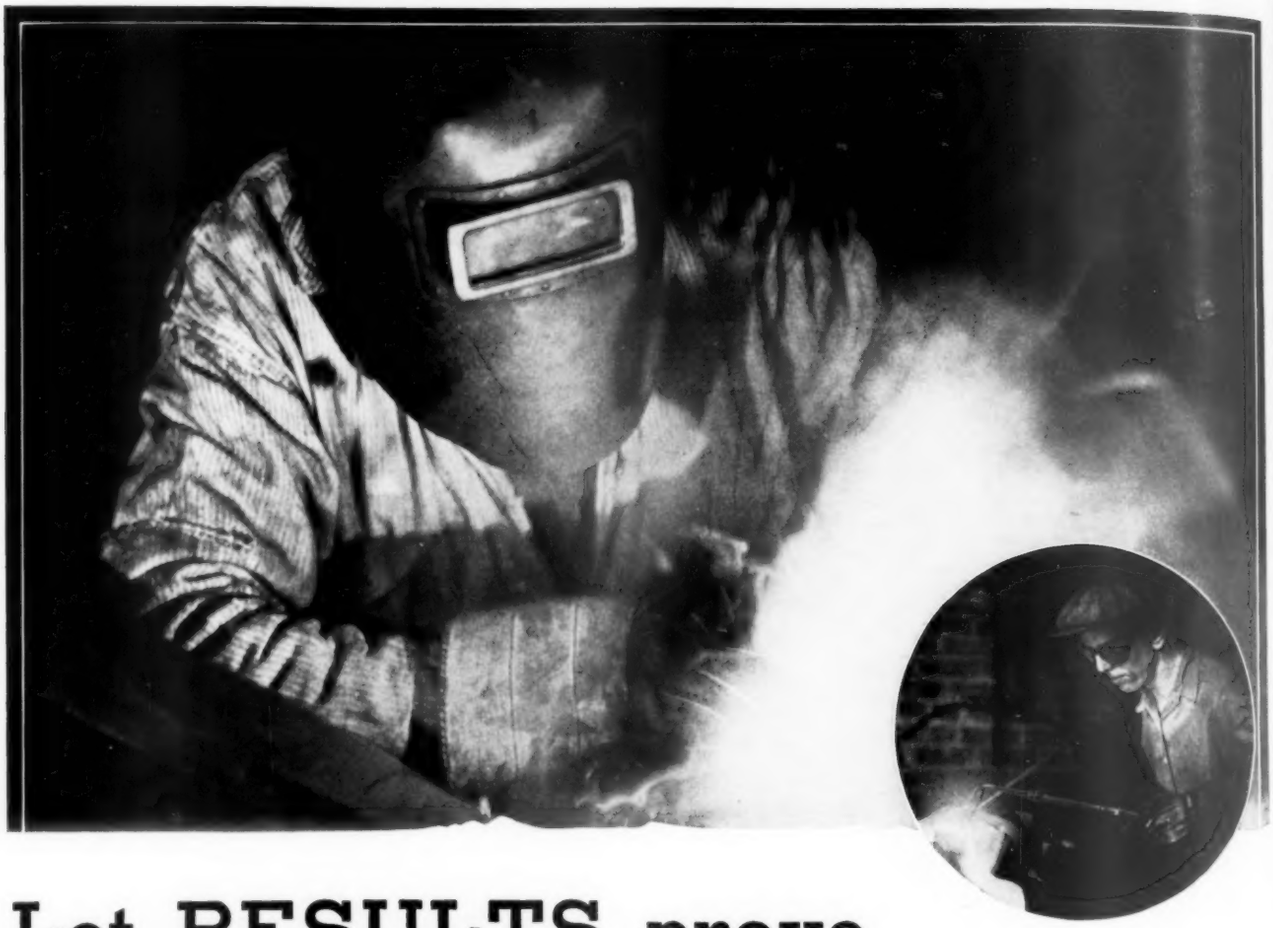

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THE WELDING ENGINEER

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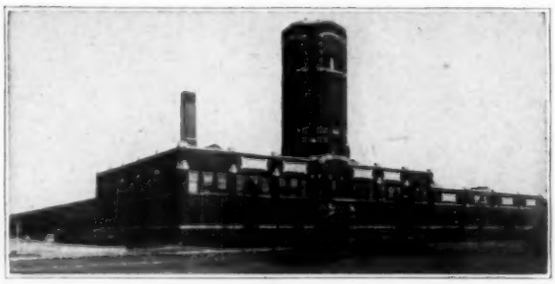

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The Welding Engineer

VOLUME 18 AUGUST, 1933 NUMBER 8

Fabricating Heavy Equipment by Welding

By A. W. LORENZ
Bucyrus-Erie Company

IN THE application of welding technique, the Bucyrus-Erie Company is fortunate in having at its disposal the extensive facilities of large machine shops, steel foundry, and structural divisions. These facilities permit fabrication of the most intricate structures, and the use of methods not otherwise available.

In order to coordinate welding operations with the general scheme of production at this plant, the welding department has been organized in two centrally located units. One of these units, intended primarily for the fabrication of small parts or parts requiring extensive machine work, is located in the main machine shop; the other, devoted to the fabrication of large structural parts, is located in the structural department. There is also a certain amount of mobile equipment for miscellaneous jobs which can be handled most expeditiously in the regular flow of production.

The machine-shop unit, being devoted particularly to the fabrication of small parts and those requiring considerable machine work, is amply equipped with jigs and fixtures for the various jobs. All jigs are of welded construction, and are carefully annealed after assembly in order to remove strains and assure permanence of dimensions. Some of the larger constructions, such as bases and frames, produced in this unit weigh as much as 15,000 lb., but in general most of the parts are small parts, comprising such articles as operating levers, pedestals, brackets, etc.

The Bucyrus-Erie Co. have a welding plant in both their machine-shop unit and structural-shop unit. In the former, small parts are welded, while booms, dippers, buckets, and other heavy work are welded in the structural shop.

The structural-shop unit is equipped for the handling of large and heavy work, usually requiring a minimum of machinery after assembly. This implies such structural units as booms and handles, dippers, drag buckets, etc. One of the recent additions to this unit is a large welding skid capable of accommodating constructions up to 65 ft. in length.

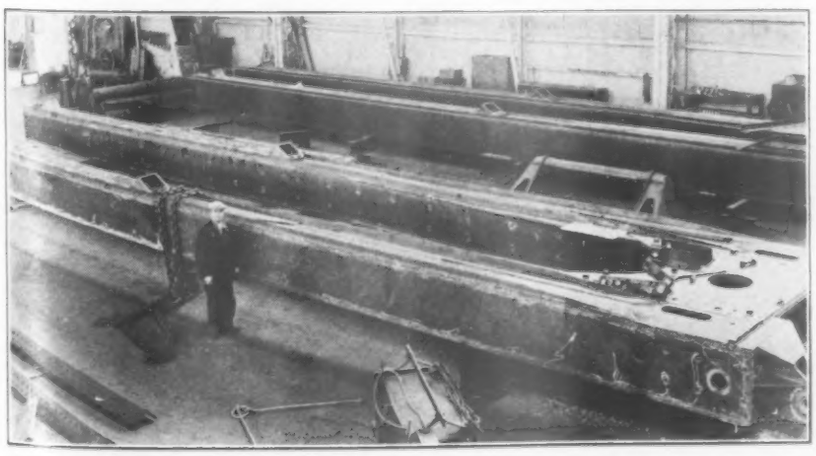


Fig. 1. 60-Ft. Arc-Welded Dipper Handle.

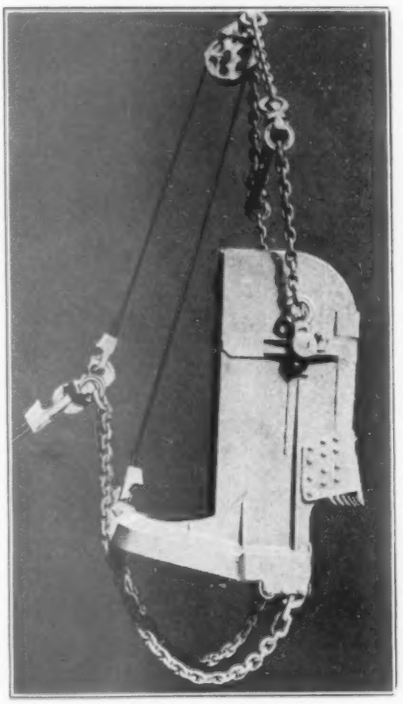


Fig. 2. Welding Makes a Stronger and Lighter Drag Bucket.

Figure 2 shows a Bucyrus-Erie, Red Arch drag bucket. These buckets are practically 100% welded construction. Besides showing certain advantages in strength over riveted construction with cast side plates, they also effect an appreciable saving in weight.

An interesting example of large bucket construction is a dipper (see the front-cover illustration) having a capacity of 20 cu. yd., being probably the largest all-welded dipper to have been made up to the present time. It is intended for service in the Kansas coal fields. The unit is an assembly of cast steel and structural members. The heavy socket-type lip is of a high-grade alloy cast steel,

which has been bonded to the structural side plates by a special method developed by the Bucyrus-Erie Company for the welding of alloy cast steels. Shielded-arc welding rod is employed throughout. The complete weight is 55,000 lb., which represents a saving of 11,000 lb., or 16% of the calculated weight of a cast dipper.

The dipper-handle shown in Figure 1 is 60 ft. long. Welded structures of this type require careful designing and well-grounded technique in order to avoid warping, twisting, and straining. These parts after completion will not show more than ⅛ in. deviation from a straight line.

In many cases, welded parts require annealing or quenching treatments after

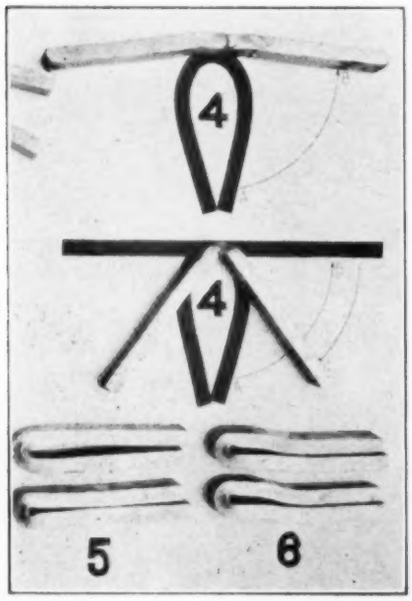


Fig. 3. Welded Specimens Tested for Ductility.

fabrication. For this purpose, extensive heat-treating facilities are available at the Bucyrus-Erie Company, ranging from large annealers capable of handling work 20 ft. square, to a thoroughly equipped heat-treating department, with automatically controlled electric furnaces and liquid quenching tanks for work of more moderate size. This shop contains five electric furnaces with a capacity of 500 tons per month.

Mention may also be made of laboratory facilities. The Bucyrus-Erie Company maintains a modern, thoroughly equipped laboratory, in which routine tests are regularly made on welded products. The type of rod now used has been adopted after extensive laboratory tests on a large number of leading commercial rods. As an illustration of the ductility shown by welds made from this rod, reference is made to Figure 3. The ½ x 1-in. bend test shown at upper 4 was bent around a 1-in. pin to the form shown by the black outline, and then back as denoted by line *AB* to the present form before breaking. At lower 4 is shown a bar which was bent together as at *A*, then straightened out as denoted by arrow *AB*, and rebent over a sharp tool to position *C* before breaking. In the lower section (denoted 5 and 6) the specimens have been pounded over flat through the welds.

Contracts for Arc-Welded Pipe With Mortar Coating

A contract for reconstructing the old Cedar River pipelines Nos. 1 and 2 has been let by the city of Seattle, Wash., to the Puget Sound Machinery Depot on its 373,323 tender. The new pipe will be electrically welded and wrapped with a mortar coating. The same company also tendered the low bid of $322,304 for electrically welded steel pipe without mortar coating.

The bid involves 25,800 ft. of 78-in. electrically welded steel pipe formed from 5/16-in. plate and covered with mortar by wrapping, also 1,300 ft. of similar pipe without mortar coating, and involves the removal of 19,000 ft. of old 60-in. wood-stave pipe. The pipe will be manufactured in Seattle and a plant will also be established there to do the mortar coating.

Cleveland Section, A. W. S. Elects New Officers

The new officers of the Cleveland Section of the American Welding Society are as follows: chairman, A. E. Gibson, general manager, Wellman Engineering Co.; 1st vice-chairman, E. R. Benedict, president, Industrial Welding Co.; 2nd vice-chairman, Geo. A. Maurath, of Maurath, Inc.; secretary and treasurer, E. T. Scott, of the Cleveland School of Welding. This election inaugurates the plan of giving the new chairman experienced assistance by electing the retiring chairman to the office of 1st vice-chairman. The section is planning only four meetings for the coming year, but these are to be outstanding gatherings.

High-Speed Trains to Employ Welding

Welding will play a part in the construction of two high-speed, light-weight trains that have been ordered by two of the western railroads.

One of these trains, it is reported, will employ a considerable amount of welded stainless-steel sheet. The other one will use arc-welded rolled-steel construction for the complete engine structure.

The contract for the arc-welded engine structure has been awarded Lukenweld, Inc., a division of the Lukens Steel Co., Coatesville, Pa. The engine will be a 600-hp., V-type, twin-six Winton unit, direct-coupled to a generator, which in turn will supply power to the driving motors and will propel the train at a speed of 110 miles per hour. The engine parts to be built by welding consist of the engine frame proper, the oil pan, and 12 cylinder heads.

The highly stressed frame will be constructed of a new high-strength alloy steel, welded by a technique that deposits weld metal having characteristics equal to the high-strength base metal, as tests have shown. The entire frame will be subjected to a radiographic examination by means of radium as an inspection check to insure the quality of the welds.

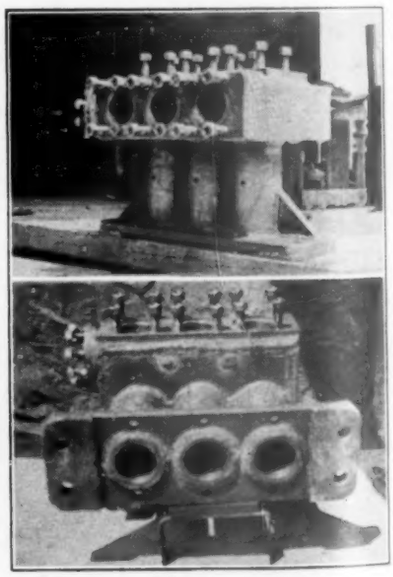
Welded Cylinder Block Saves $100 Over Casting

Replacing a cast-iron cylinder block which proved inadequate for a 2,000-lb. triplex oil pump, the Page Manufacturing Co., Oil City, Pa., designed and built an arc-welded steel cylinder block for $100 less than the cost of a steel casting, the only alternative method of construction.

In the welded design, which is shown in the accompanying photographs, the design of the casting was followed fairly closely, except that the metal was placed more advantageously from the strength standpoint. On the suction end a ½-in. plate was used and on the high-pressure side a 1¼-in. plate. To provide additional strength, two 1-in. stay bolts were put in this chamber.

All welding was done by the shielded-arc process, using Fleetweld electrodes manufactured by The Lincoln Electric Co., Cleveland, Ohio.

The welded cylinder cost only $150 to



Views of Pump Cylinder Block.

build as compared with $250 for a steel casting. The welded cylinder is proving perfectly satisfactory in service and is claimed to be stronger and more rigid than the casting. The cylinder was built in much less time than is required for securing a casting.

Intergranular Corrosion

at or near the weld in

Austenitic Stainless Steels . . .

presents a problem to which several solutions are offered

AUSTENITIC stainless steels of the 18-8 type, after exposure to a temperature in the general vicinity of 1000° to 1500° F., are frequently found to be subject to a very characteristic form of intergranular corrosion, as shown in Figure 1, even in environments which ordinarily have no effect upon the normal alloy. Thus, metal near a weld sometimes literally disintegrates in use with solutions which do not attack the remainder of the article, or sheets of the alloy suffer loss of strength during pickling after an improper heat-treatment has been permitted. This metal, when in a condition "sensitive" to intergranular attack, can be restored to the normal corrosion-resisting state by heating to a temperature in the neighborhood of 1650° to 2000° F., followed by rapid cooling, but this treatment is impracticable in many cases.

Conditions producing this sensitization and means of reducing or eliminating it altogether have been investigated by E. C. Bain, R. H. Aborn, and J. J. B. Rutherford, of the research laboratory of the United States Steel Corp., at Kearny, N. J., and were recently reported in an extensive treatise, published in the June *Transactions* of the A. S. S. T., from which the following abstract has been prepared.

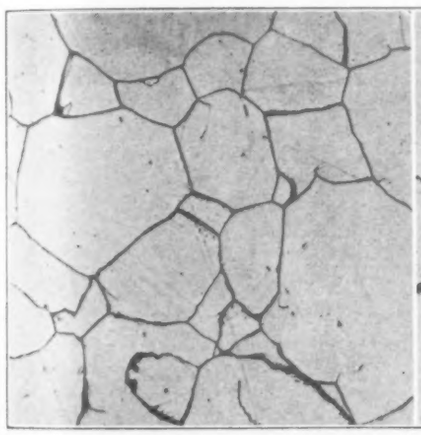


Fig. 1. Photomicrograph of Disintegrated Metal, After Sensitization and Corrosion.

(Magnification, 60 diameters. If the attack is allowed to penetrate through and through, the metal may crumble to powder, the particles of which are the crystal grains of the metal.)

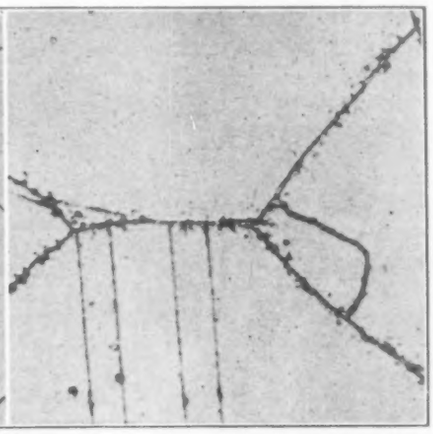


Fig. 2. Photomicrograph Showing Carbide Particles Precipitated in Grain Boundaries.

(Magnification, 1800 diameters. Such metal is, in general, susceptible to intergranular attack.)

Why Corrosion Takes Place

The behavior of austenitic stainless steels may be explained as follows: The carbon, largely dissolved at high temperatures and permanently retained in supersaturated solution at ordinary temperatures, is rejected in the form of a chromium-rich carbide in the grain boundaries at intermediate temperatures (see Figure 2), resulting in a depletion of chromium in the metal adjacent to each carbide particle to the extent that the resistance to corrosion is impaired. Accordingly, a vulnerable pathway through the metal is opened up along the grain boundaries wherever this fine carbide precipitation occurs.

Apparently there is some chromium migration into the depleted zone, but it is not rapid. However, after a comparatively long time, chromium evidently diffuses into the impoverished zone from the more than adequate store in the

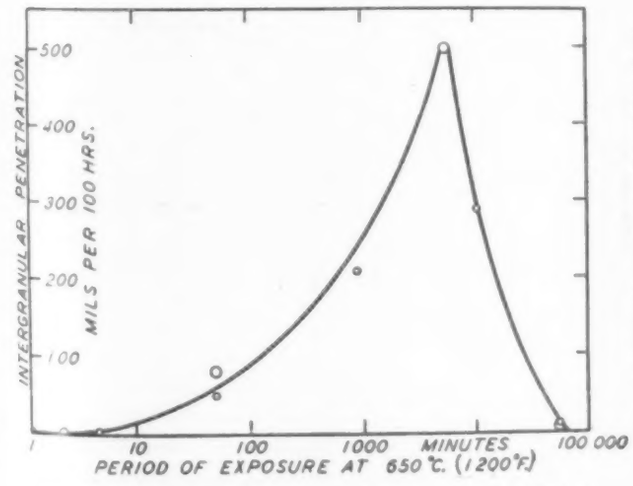


Fig. 3. **Curve of Sensitization and Restoration at 1200° F.**

(Using alloy with carbon content of 0.08%.)

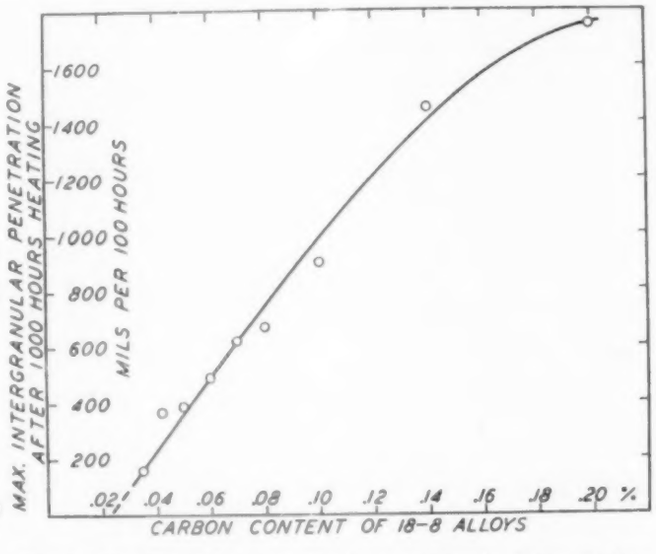


Fig. 4. The Dependence of Maximum Sensitivity Upon Carbon Content.

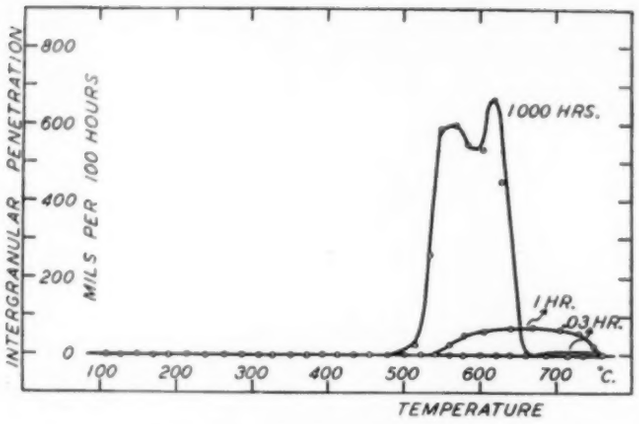


Fig. 5. Sensitivity in Annealed Alloy as Developed in 2 Minutes, 1 Hour, and 1000 Hours at a Series of Constant Temperatures.

(Using alloy containing 18.1% chromium, 8.9% nickel, 0.08% carbon.)

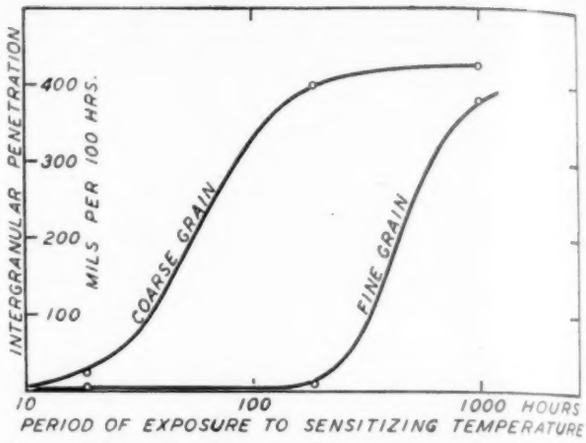


Fig. 6. Relative Development of Sensitivity in Coarse-Grained and Fine-Grained Alloys.

(Using alloy containing 17.6% chromium, 8.8% nickel, 0.05% carbon.)

grains, with the attendant recovery of corrosion resistance in the grain boundary region. For a temperature of 1200° F., the increase and subsequent decrease of sensitization with time is shown in Figure 3.

That the development of a condition in the 18-8 alloy wherein corrosion proceeds rapidly along the grain boundaries is greatly influenced by the carbon content can be seen in Figure 4. Heating for 1000 hours at the severest temperature possible induces in the low-carbon alloys only a fraction of the susceptibility found in the higher-carbon alloys. That neither the chromium content within the range 15% to 19%, nor nickel within the range 7.5% to 11%, nor the sum of the two (100% — "residual iron") has any insignificant effect may be inferred likewise from an inspection of the figures in the accompanying table, in which the attack parallels the carbon content but shows no correlation with the nickel, chromium, or iron content of the alloys. Experiment indicates that the alloys carrying less than about 0.02% carbon are entirely free from intergranular attack.

How Various Factors Affect Susceptibility to Attack

The characteristics of sensitization are summarized as follows:

1. The susceptibility to the specific intergranular corrosion to which austenitic stainless steel is subject increases in severity with continued heating at a temperature in the intermediate range; it reaches a maximum and then with further heating begins to lessen. At the low sensitizing temperature this recovery may not begin in less than thousands of hours and is therefore not ordinarily observable. At higher temperatures the recovery may begin in a few hours or less. This is shown graphically in Figure 5.

2. The severity of the sensitization is proportional to the carbon content of the alloy with little regard to the content of chromium and nickel within the normal limits for the 18-8 or 18-12 alloys (see the accompanying table and Figure 4).

3. Coarse-grained is sensitized more rapidly than finer-grained metal, as indicated by the curves in Figure 6.

4. Alloys of the ordinary 18-8 compositions develop some small amount of ferrite and therefore become magnetic with sensitization. The maximum magnetic induction does not coincide with maximum sensitivity and higher nickel alloys becomes sensitive without becoming magnetic.

5. An intergranular precipitation of a phase, almost certainly carbide, clearly visible in the microscope as very fine particles (see Figure 2), typifies the sensitive metal.

Effect of Carbon Content on Intergranular Attack.

Analysis of Alloy				Max. Intergranular Penetration, Mils per 100 Hours (after 1000 hours of heating)
C %	Cr %	Ni %	Cr + Ni %	
.035	15.5	8.1	23.6	160
.04	19.2	7.7	26.9	370
.05	17.4	8.8	26.2	390
.06	16.3	8.4	24.7	490
.07	17.5	8.9	26.4	620
.08	16.5	11.3	27.8	580
.08	18.1	8.9	27.0	670
.10	18.6	9.0	27.6	900
.14	16.5	8.6	25.1	1450
.20	17.5	8.6	26.1	1750

6. The actual intergranular corrosion dissolves a relatively wide pathway through the metal along the grain boundaries. The carbide particles are probably not dissolved but the portion of the grain near the grain boundary appears to vanish.

7. The plasticity of the 18-8 alloy is somewhat reduced with sensitization, and its hardness and strength increase.

8. Cold-worked metal is more rapidly sensitized, but ultimately never so severely as the annealed, and it promptly begins to be restored with further heating (compare Figure 7 with Figure 5). In this case carbide separation occurs on all slip planes substantially as effectively as upon grain boundaries, giving the effect of a general rather than localized precipitation, as shown in Figure 8.

9. In two-constituent alloys, carrying ferrite pools, carbide rejection shows a preference for the ferrite regions which do not show the sensitization imparted

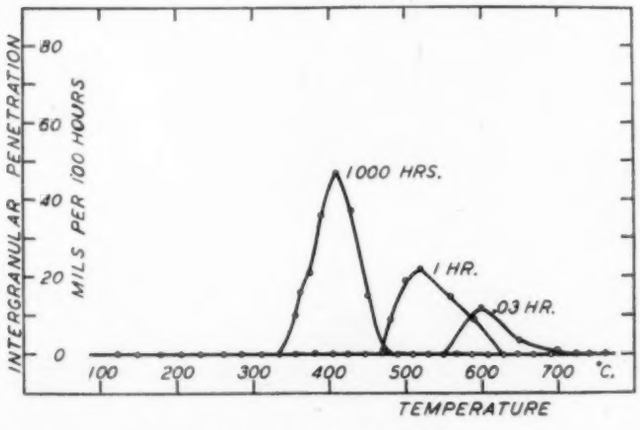


Fig. 7. Sensitivity in Cold-Worked Alloy as Developed in 2 Minutes, 1 Hour, and 1000 Hours at a Series of Constant Temperatures.

(Same alloy as referred to in Fig. 5. In making comparison, note difference in scale.)

to the purely austenitic alloys. The presence of ferrite therefore usually reduces sensitization.

The data presented in this paper refer to a purely intergranular corrosion in a solution of copper sulphate and sulphuric acid which causes no loss in weight on normal (unsensitized) metal but which is adjusted in concentration to produce the severest possible intergranular attack upon sensitive material. The susceptibility of the intergranular metal, with respect to its failure to equal in resistance the normal grains themselves, is the only factor tested, and in all cases this is evaluated by the change in electrical resistance caused by the stated immersion in this particular corrosive medium, and the penetration is computed in mils per 100 hours immersion on the basis of a linear-time relation.

Not Practicable to Reduce Carbon to Solubility Limit

The results of these tests lead to the conclusion that the reduction of the carbon content to the solubility limit—approximately 0.02% at temperatures below 1000° F. (540° C.)—would eliminate sensitization altogether, but such a course is impracticable at present, the authors point out. [Austenitic stainless steel sheets are available having a maximum carbon content of 0.07%, which, it is claimed, under the conditions met with in welding show a degree of sensitization so low that, for many practical purposes, it can be ignored.]

Another possibility of preventing intergranular corrosion, the tests show, lies in the use of cold-worked metal which is desensitized by a suitable heat-treatment. In ordinary annealed metal, the period

Fig. 8. General Carbide Precipitation Upon Slip Planes Within the Grain.

(Magnification, 1200 diameters. Using cold-worked 18-8 alloy.)

for spontaneous recovery is impracticably long when the desensitizing temperature is sufficiently near the temperature of subsequent heating. On the other hand, the restoration of cold-worked metal proceeds with satisfactory velocity at temperatures even as low as 1290° F. (700° C.) and the subsequent heating is without appreciable effect.

Addition of Titanium or Other Element to Prevent Corrosion

Still a third method of preventing intergranular corrosion consists in the addition of any one of several elements (titanium, columbium, or possibly tantalum), which in adequate concentration has the property of combining with most of the carbon to form its own carbide to the substantial exclusion of chromium carbide, thus preventing impoverishment of chromium and causing the metal to retain its unsensitized condition upon heating.

The authors cite the results of a test in the standard solution of copper sulphate and sulphuric acid which, even when prolonged to 1000 hours, had no measurable effect upon the titanium-bearing alloy previously exposed to temperatures ranging from 400° to 1600° F., while the ordinary material previously heated in the temperature range 950° F. to 1100° F. disintegrated to a powder in less than 10 hours.

In adding titanium, it is important that the element be introduced, without simultaneous addition of carbon, in such a manner as to insure its preservation in the metallic state, since its efficacy depends upon its combining power with carbon. The proportion of titanium required has been experimentally determined as being approximately 6 times the carbon content in excess of 0.02%. Moreover, the alloy must be so treated, prior to its final fabrication, that opportunity is provided for the titanium to accomplish its purpose. When so treated the alloy is designated as "stabilized." Figure 9 shows comparative results of torsion tests of welds in regular 18-8 alloy and in stabilized titanium-bearing 18-8 alloy, both after being subjected to a corrosive solution.

No Advantage Obtained From Excess of Titanium

Addition of titanium in excess of the ratio given above serves to provide a certain margin of safety in metal that has been much overheated prior to exposure to temperatures that would sensitize ordinary metal. This is usually entirely unnecessary and tends in the extreme case to develop ferrite in the otherwise austenitic alloy—a circumstance contributing to magnetic induction and a small change in mechanical properties. There is little gained by a high titanium ratio, and at the same time there are no significant advantages, except in special cases. If ferrite is disadvantageous, higher nickel may be employed to eliminate it.

The mechanical properties of a typical titanium-bearing 18-8 alloy are as follows:

	16-Gage Sheet	Seamless Tube
Ultimate strength, lb. per sq. in.	95,000	91,000
Yield point, lb. per sq. in.	37,200	47,000
Elongation in 2 in.	55%	56%
Reduction of area		54%
Rockwell "B" hardness	82	83

Analysis: carbon 0.07, nickel 9.12, chromium 18.08, titanium 0.38.

Alloy Immunized by Heat Treatment

Under many conditions of heating and cooling, there is a tendency for a small, though significant, amount of chromium carbide to form in the titanium-bearing

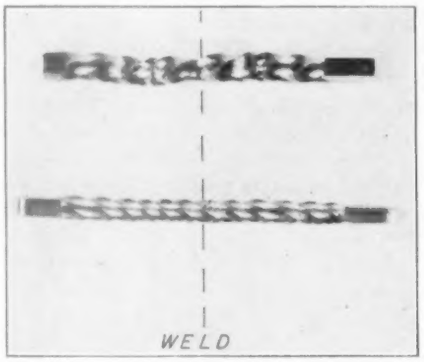


Fig. 9. Weld Specimens in Regular and Titanium-Bearing 18-8 Alloys After Being Subjected to a Corrosive Solution, Then Twisted.

(Note cracks in regular material in a zone on each side of the weld. The regular 18-8 specimen (upper view) was subjected 260 hours to a corrosive solution, and the titanium-bearing alloy (lower view) was subjected to the solution for 750 hours.)

alloy unless substantially all of the carbon has been fixed as titanium carbide. This stabilizing treatment which consists in heating for a period of two to three hours at 1560° F. (850° C.) accomplishes complete immunization of the alloy, and is the customary procedure employed in preparing the titanium-bearing material for welding or other treatment involving heating at intermediate temperatures.

Industry Submits Codes Under NIRA

The National Oxygen & Acetylene Association is a new organization of manufacturers of gas welding and cutting equipment and supplies recently formed at a meeting held in Chicago. A "code of fair competition" has been drawn up by this association to apply to manufacturers in the industry and has been submitted for approval to the NRA. The president of the new organization is John R. Gobey, of Columbus, Ohio, upon whom will devolve the task of administering the code after it is approved.

A "code of fair competition" for the electrical manufacturing industry, including manufacturers of arc welders, has been drawn up by the National Electrical Manufacturers Association and been submitted to Washington for approval.

The Fundamental Characteristics and Technique of

Spot Welding Various Metals—II

(Second in a Series of Two Articles)

■ By LAWRENCE FERGUSON
Member of Technical Staff,
Bell Telephone Laboratories, Inc.

THE variables of size and shape of electrode tips are important in adjusting the heating not only of dissimilar metals but also of unlike thicknesses of a single metal. Although the place where the highest temperature is reached in the pieces being welded is determined by the combined effect of current density, cooling by conduction, and contact resistance, the contribution of contact resistance is of minor importance. This is shown by the large fraction of the thickness raised to the welding temperature, as indicated by the shrinking and indentation commonly occurring in spot welds. Moreover, in practice, the contact resistance is minimized by cleaning the pieces to be welded and by applying pressure to hold them tightly together. Even when the contact resistance is quite appreciable, however, it is obvious that current density and cooling by conduction have their own independent effects on temperature.

The effect of current density and of cooling by conduction is illustrated in Figure 6 by showing the paths of welding current and the area reaching the highest temperature. When the electrode tips used for welding are alike in material, size, and shape, the path of the welding current and the hottest region are as shown in Figure 6(A, B). Here the current density is greatest at the electrode tips, but so, also, is the cooling by conduction. If the metal strips being welded, therefore, are of equal thickness, Figure 6(A), their point of contact and the hottest area will coincide.

Welding Strips of Different Thicknesses

When the strips differ in thickness, however, Figure 6(B), the hottest region tends to lie within the body of one of them. By using a smaller electrode tip against the thin strip than against the thick one, the current density in the thin piece is made greater and the cooling less. The hottest region in the strips, therefore, shifts toward the thin piece as shown in Figure 6 (C, D).

On the basis of this analysis, and its agreement with various experimental results,[7] it seems desirable to recommend the use of a smaller tip against the thinner metal instead of the opposite as recommended in Gillette's paper[1] and in the Welding Encyclopedia.[8] A diagram of Gillette's analysis is shown in Figure 7.

In choosing electrode tips for a particular spot-welding job, it should be remembered that, for special reasons, or if a small depression or discoloration is undesirable in the finished work, it may be necessary to use a flat electrode tip of a suitable size. In general, however, slightly rounded or dome-shaped electrode tips permit easier control of welding conditions, give more uniform results, and are more easily kept in proper adjustment. The dome of these electrode tips may be considerably flattened (almost to the point of becoming flat tips) to prevent denting the work or to increase the size of the welded spot, but there should always be at least a slight roundness.

With dome-shaped electrode tips, the current density always is higher at the center of the tip than elsewhere, and this

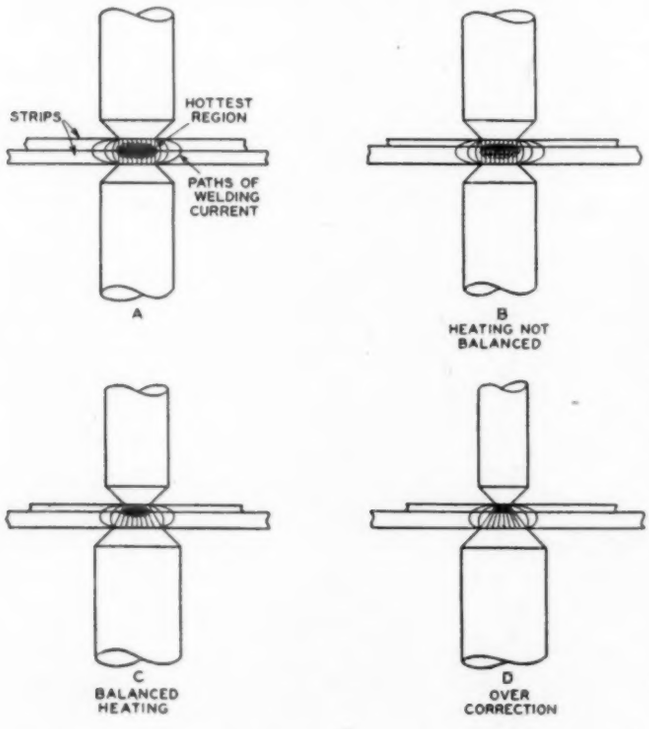


Fig. 6. Schematic Diagram of Current Density and Hottest Region, When Spot Welding with Electrode Tips of Different Sizes.

(Current density is indicated by the number of paths of current shown.)

[1] "Spot Welding of Dissimilar Metals," General Electric Review, Vol. 30, no. 9, p. 443 (1927).

[7] Some of these experimental results are: (1) More power was required to weld thick strips of iron to comparatively thin ones when following Gillette's recommendation than when the new technique was used. (2) With the minimum power that is required to obtain a good weld under each of the conditions stated above, the thick strip was apt to melt or burn at its point of contact with the electrode tip more frequently with Gillette's technique. (3) With careful control of the welding conditions, and electrode tips chosen in accordance with the new recommendation, welds were made, at will, between any two of a stack of four strips of iron without welding any of the others.

[8] Welding Encyclopedia, page 287, seventh edition, 1930, The Welding Engineer Publishing Company.

Table II. Open-Circuit Voltages Used for Spot Welding with Different Electrode Tips.

Metals Welded	Voltage with High-Dome Elkaloy Tips	Voltage with Shallow-Dome Elkaloy Tips	Voltage with Elkonite No. 3 Tips (Tungsten)
Aluminum	2.28	3.26	
Brass	2.1	3.55	
Bronze	2.28	3.55	
Aluminum to Allegheny Metal	2.55		1.45*
Aluminum to Stainless Iron	2.55		1.5*
Aluminum to Iron	1.93		1.45*
Tin to Copper	2.00		

*Elkonite No. 3 used against the aluminum only. Elkaloy used against the other metal.

**Elkonite No. 3 used against the copper only. Elkaloy used against tin.

always fixes the position of the weld beneath the center of the tip. With flat electrode tips, on the other hand, there may be a higher current density at an edge of the tip making better contact with the work to be welded, and the weld may vary in position and size accordingly. High-dome[9] tips give smaller spots and require less welding power than shallow-dome[9] tips under the same conditions, and the standard small tungsten tips require less power than the standard dome-shaped elkaloy tips. Table II shows the open-circuit voltages used in this work for spot welding some materials with different electrode tips.

The local heating accompanying spot welding may be harmful to some metals. Thus, zinc is recrystallized and made brittle, iron is slightly oxidized, zinc is partly distilled out of brass, and duralumin and tool steels may be given an undesirable heat treatment. The area of local heating and undesired effects can be reduced considerably, without reducing the actual size of the spot weld, by making welds under the surface of a cooling liquid such as water.[10] When iron is spot-welded under water, for instance, the same conditions and welding power are used and practically the same size weld is obtained, but there is no sign of oxidation or of heating in the metal around the weld.

[9] "High dome" and "shallow dome" refer to the shape of the contact surface of electrode tips, high domes having a comparatively small radius of curvature.

[10] Pfeiffer (see foot note 2) mentions welding under carbon tetrachloride in order to keep permalloy from becoming brittle.

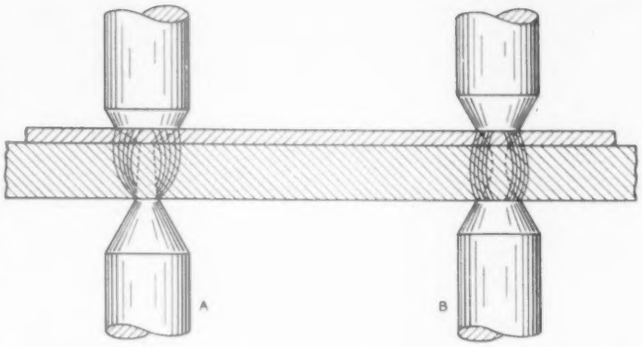


Fig. 7. Heat Distributions of Two Electrode Combinations, Showing How and Why Electrode Shape Should Be Adjusted to Metal Thickness.

(After R. T. Gillette.)

Metal Parts Should Be Cleaned of Dirt and Scale

Only clean metal parts can be spot welded properly, because the best technique is almost useless against grease, dirt, or scale. Even higher contact resistance, induced purposely by chemical action, tends to prevent good welding results, because it greatly increases the likelihood of having the welding current surge through whatever small area happens to weld first.

Scale and dirt, moreover, not only mix in the weld material, making it brittle and porous, but also make a poor electrical contact which prevents the proper flow of welding current. If the welding voltage is increased to break through the contamination, there may be a surge of current, at the instant of welding, great enough to ruin the weld and cause flashing. There is seldom any chance of finding a medium welding potential that just balances the effect of dirt and scale, or of regulating the duration of current flow. The only satisfactory course is to clean dirty or scaly materials.

M. L. Eckman[11] mentions several methods of spot welding copper and other metals having high electrical conductivity. He suggests that two copper pieces can be welded together easily if the contact resistance between them be sufficiently increased. In one of the methods he describes, an iron shim is inserted between the two copper pieces. The high resistance of the iron consumes sufficient power to melt the adjacent copper and cause welding. A disadvantage of this system, however, is that an alloy is formed in the weld—a condition not always desired, especially in some types of electrical work.

Using Shims of Dissimilar Metal

Neglecting possible ill effects of an extraneous metal, shims can be very useful in joining two metals which do not ordinarily form good welds. Thus, although tin and nichrome do not weld together, they may be joined through a brass shim, because they both weld to brass.

Eckman's recommended method of spot welding copper consists in reducing the welding pressure of the electrodes to the minimum required to prevent arcing, but in his argument he neglects the fact that this also reduces the pressure and increases the contact resistance and heating at the electrode tips. Reference to the previous discussion on the spot welding of high-conductivity metals, and to Figure 4(C), shows that this method would not produce better welds, but it may decrease the welding current required. The projection-welding method, Figure 4(D), however, still remains best for metals of high conductivity.

[11] "Spot Welding Non-Ferrous Metals," The Welding Engineer, page 44, October 1929.

Table III. Details of Specimens Used for Spot-Welding Tests.

Chart Name	Material	Nominal Composition	Size of Specimen, In. Thickness	Width
Iron	Cold-rolled Steel	100% Fe	.025	.250
Stainless Iron	Ascoloy 33	85% Fe, 14% Cr	.025	.250
	Carpenter Metal No. 1	87% Fe, 13% Cr	.025	.250
	Nevastain RA	81% Fe, 16% Cr, 1% Si, 1% Cu, 4% Mn	.002	.375
Allegheny Metal	Allegheny Metal	72% Fe, 18% Cr, 9% Ni	See footnote (1).	
Cobalt Steel	Vanadian Cobalt Steel	49% Fe, 49% Co, 2% V	.025	.250
Nickel	Nickel	100% Ni	.015	.250
Nichrome	Nichrome	61.5% Ni, 26% Fe, 12.5% Cr	See footnote (2).	
Monel Metal	Monel Metal	60% Ni, 33% Cu, 6% Fe	.032	.250
Nickel Silver	Grade "B" Nickel Silver	55% Cu, 27% Zn, 18% Ni	.025	.250
Brass	Grade "A" Brass	66% Cu, 34% Zn	.025	.250
	Grade "G" Brass	72% Cu, 28% Zn	.028	.250
Bronze	Grade "C" Phosphor Bronze	91% Cu, 8% Sn, .05% to .25% P	.020	.250
Manganin	Manganin	70% Cu, 25% Mn, 5% Ni	.025	.250
Everdur	Everdur	95.5% Cu, 3% Si, 1% Mn	.020	.250
Copper	Copper	100% Cu	.002	.375
Aluminum	Aluminum	100% Al	See footnote (3).	
Magnesium	Magnesium	100% Mg	.033	.250
Molydenum	Molydenum	100% Mo	.025	.250
Lead	Cable Sheath	99.95% Pb, 0.04% Ca	.250-in.-diameter rod See footnote (4).	
Tin	Bar Tin	100% Sn	.007	.400
Cadmium	Cadmium	100% Cd	See footnote (5).	
Zinc	Zinc	100% Zn	.125	.500
Galvanized Iron	Galvanized Iron	—	.040	.500
Tin Plate	Tin Plate	Heavy tin coating on iron	.030	.500
Chromium-plated Steel	Chromium-plated Steel	Steel, plated with 40 MSI of nickel and then 10 MSI of chromium	.025	.250
Nickel-plated Brass	Nickel-plated Brass	Grade "A" brass with commercial nickel plate	.022	.250
			.030	.250
			.060	.250
			.021	.250

[1] Eight strips were usually used together. [2] Sometimes 2 strips were used together. [3] Eight strips were usually used together. [4] Flat electrode tips used. [5] Two or three strips usually used together.

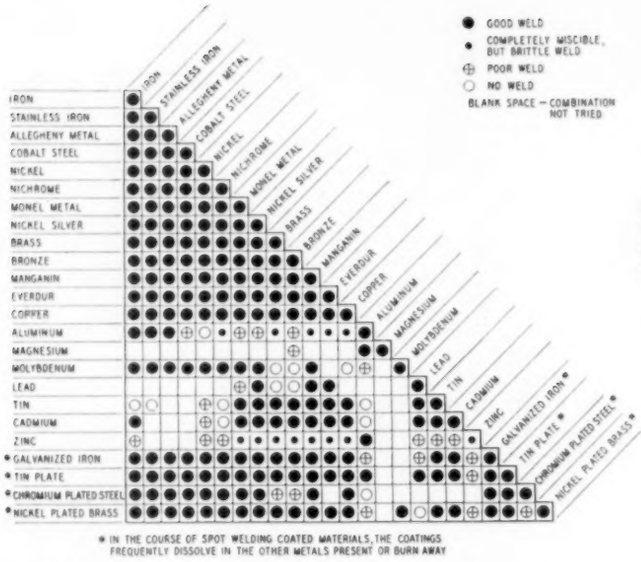


Fig. 8. Spot-Welding Possibilities, at Present, of Different Metal Combinations.

(Including those of R. T. Gillette.)

Table IV. Average Open-Circuit Voltage Used for Spot-Welding Various Metals.

Metals	Voltage
Iron	1.5
Stainless Iron	1.8
Allegheny Metal	1.9
Iron	1.5 *
Nickel	1.9
Aluminum	2.0
Copper	2.3
Tin	1.5
Zinc	1.6
Cadmium	1.9
Nickel-plated Brass	2.0
Brass	2.1
Nichrome	1.6
Monel Metal	1.8
Nickel Silver	1.9
Nickel	1.9
Manganin	1.6
Nickel Silver	1.9
Brass	2.1
Bronze	2.1
Copper	2.3
Iron	1.5
Galvanized Iron	1.7
Tin Plate	1.8

The values given in this table for each metal are, approximately, the average of open circuit voltages given in Figure 9 for all combinaitons with the metal.

Welding Characteristics of Metals

The chart in Figure 8 shows which of 250 combinations of metals can and which cannot, at present, be successfully spot welded. Table III gives details of the size, shape, and composition of the specimens used.

Figure 9 shows the actual open-circuit welding voltage used for each combination. Open-circuit welding voltages are given instead of current densities, because of the impracticability of measuring and reproducing current densities even approximately. Although voltages given are directly applicable, approximately, only to 60-kva. No. 2 Gibb welding machines under the conditions (electrode size, pressure, specimen thickness, etc.) described in this paper, they have considerable indirect value. First, they give useful comparisons of the power required for welding various combinations of metals. Second, since most spot-welding machines have an internal resistance in keeping with their power capacity, and have a voltage adjustment for regulating heating power, the open-circuit voltages given here should be useful in estimating the proper voltage settings for these machines.

In compiling the data in Figure 8, some welds obtained, while showing good fusion and miscibility, were weak because of the weakness of the weld material. Thus, many zinc welds were weak only because of the brittleness of recrystallized metal at the weld. These welds are appropriately marked "completely miscible, but brittle weld." If, in a weak weld, one metal wet another but did not alloy appreciably, the weld was considered poor. Where there was no wetting or alloying, no weld could exist, although sometimes there was some mechanical adhesion. Different results from those given in Figure 8 may be found in a few instances by other workers if the welding conditions are greatly modified.

In comparing the welding voltages given in Figure 9, no importance should be attached to the precision of the values presented. These values are given to hundredths of a volt only to identify (in conjunction with Table I) the particular transformer settings ordinarily used. The welding conditions for some metals are so far from critical that some voltages given in Figure 9 may be varied as much as $\pm 25\%$ without other effect than changing the size of the welded spot. The welding voltages given are affected by certain variables, such as the size, shape, and composition of the materials as shown in Table III.

The potential needed to weld to the coatings of materials like tin plate and nickel-plated brass is different from that required to weld to the base metal. Ordinarily, however, the coatings of these materials disappear either by solution in the other metals present or by oxidation.

The different values of internal resistance of various welding machines must be considered in transferring the open-circuit voltages of Figure 9 from the No. 2 Gibb machine on which they were obtained to machines having different power capacities.

Small changes in the chemical composition of metals (such as between grade "A" and grade "G" brass) have practically no effect on the voltage required for welding or on other welding characteristics. In general, however, gross changes in composition have, at least, a small effect.

Table IV shows the average comparable open-circuit voltage required to weld certain metals. The metals are arranged in groups to show the effect of changes in the amounts of various constituents and the effect of various coatings. Thus, a large change in composition, such as from monel metal to nickel silver, causes a change of only 5.5% in welding voltage.

The effect of thickness of the metals on the power required for welding differs with different metals. The results of tests

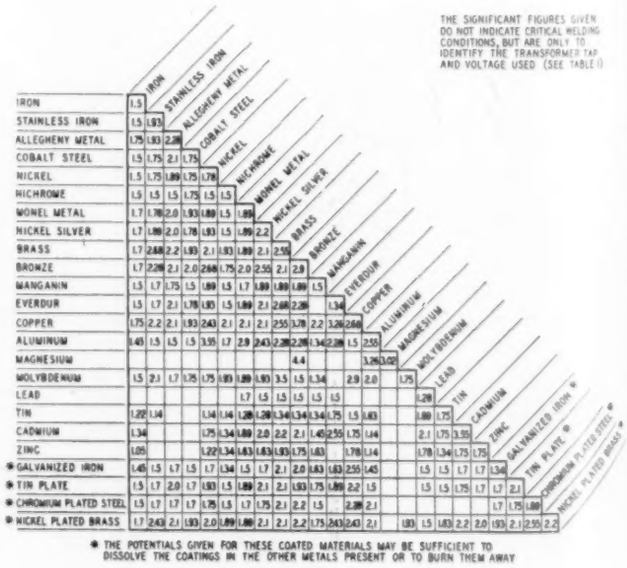


Fig. 9. Open-Circuit Voltages Used for Spot Welding Various Combinations of Metals.

(Duration of Current Flow, 0.17 second.)

Table V. **Change in Open-Circuit Welding Voltage With Thickness of Metal Specimens Welded.**

Metal	Thickness, In.	Number of Strips Welded Together	Open-Circuit Welding Voltage	Percent Increase in Voltage for 100% Increase in Thickness
Brass	.028	2	2.1	
	.040	2	2.7	40%
Cadmium	.030	2	3.6	
	.030	4	3.6	0
Iron	.025	2	1.5	
	.025	4	1.9	27
Galvanized Iron	.022	2	1.3	
	.022	4	1.9	46
Monel Metal	.025	2	1.9	
	.025	4	1.9	0
Nichrome	.025	2	1.5	
	.025	4	1.7	13
Nickel	.032	2	1.8	
	.032	4	2.0	11
Nickel Silver	.025	2	2.2	
	.025	4	2.2	0
Tin Plate	.030	2	2.1	
	.030	4	2.9	38
Zinc	.025	2	1.7	
	.025	4	1.9	12
			Average	19%

on ten metals are shown in Table V. The average for all ten was found to be about a 19% increase in open-circuit welding voltage for a 100% increase in thickness of metal welded.

Summary

In this paper there are described the spot-welding process, the apparatus and method used, the technique of spot welding (including a discussion of some of the practical problems involved and their solution), and the welding characteristics of metals. A chart is presented showing which of 250 combinations of metals can and cannot be spot welded at present.

Oxygen Generated by Stored Chemicals

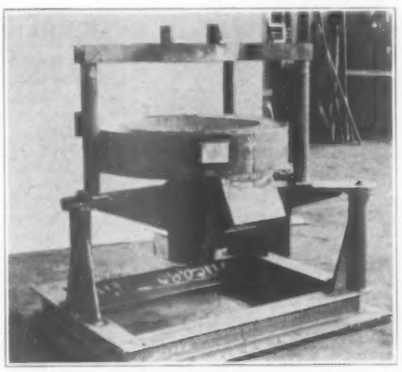
A German firm has produced a powder which, on ignition, evolves oxygen at a pressure of about 15 atmospheres, says a report in a recent issue of *The Welding Journal* (London). It is claimed that, compared with oxygen compressed into bottles, a saving of freight of two-thirds may be effected. No further details are given.

Centrifugal Extractor of Welded Design

In the construction of the parts going into the extractor shown in the illustrations, it was necessary that they fit with such perfection that every plane of contact between the parts be horizontal and these planes be parallel to a very high degree of accuracy. In addition, the bearing had to be welded in place so its center line would be perpendicular to these planes.

Naturally, extreme accuracy was required in the making and fitting of all parts, notwithstanding which it was decided to assemble all parts by welding. Special precautions had to be taken against distortion due to the welding heat and to expansion and extraction of the weld metal and adjacent parent metal.

The job was accomplished in the shop



All-Welded Extractor Built of Spare Parts and Scrap.

of the Evers-Sauvage Engineering Co., 1025 S. Menard Ave., Chicago, Ill. After completion, the rotor was set in operation and no vibration was evident, indicating very close tolerances and skillful workmanship.

The main parts of the extractor are the base, bearing housing, and mixer and discharge chamber. Almost all parts were welded out of scrap and miscellaneous pieces.

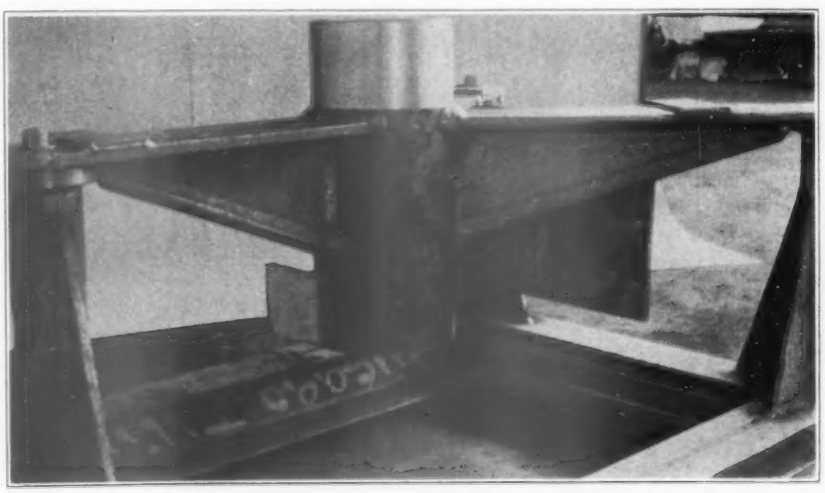
The base consists of bulb angles mitered at the corners and welded. Pads welded on at the four corners have their faces machined so the base will sit truly level. Three lengths of pipe welded upright to the base with web plates welded to the corners, form the support for the bearing housing, which is formed of double-extra-heavy 8-in. pipe with rings welded in at the top and equipped with roller bearings.

Three arms formed of plate to support the bearing are welded directly to the bearing housing and to web plates, to the long side of which are welded 1-in. iron bars to give strength and rigidity and cut down weight.

The center line of the bearing had to be perpendicular without any perceptible deviation. The welding of this part therefore required careful planning and a great amount of skill in handling the arc. The welder, W. A. Owens, used Hollup 3R (bare wire) electrodes of 5/32-in. size, with about 150 to 160 amperes, or about 20% greater heat than normal. A steady arc was used without weaving, and the bead was not laced as usual but was laid straight, as the close-up view shows. Care was taken to work out all strains as the welding progressed so distortion would not result, and the arc was never broken on a shearing point.

The three supports for the mixer and discharge chamber are also made of pipe, with shoes welded on the bottom which rest on corresponding pads welded to the three arms supporting the bearing. The surfaces of all shoes and pads were milled on horizontal planes, about 1/32 in. of metal being taken off.

The shaft, including three discs, weighs 900 lb. and revolves at 3300 r.p.m. This was the first machine of this type to be built.



Close-Up View Showing Bearing Housing and Part of Base.

Tentative Program for A. W. S. Fall Meeting

The tentative program for the 13th fall meeting of the American Welding Society, to be held at the Book-Cadillac Hotel, Detroit, beginning Monday afternoon, October 2nd, and continuing through Thursday of that week, contains a list of papers on welding of various metals and alloys, welding processes, testing, and other topics, by authorities in the field.

The welding of chrome alloy steels, oxygen-free copper, Everdur, structural nickel steel, galvanized steel, and various other alloy steels and non-ferrous metals will be discussed. The program also includes papers on impact resistance tests, tensile tests of welded and riveted joints, fatigue tests, and determination of internal stresses.

In the field of fabrication, topics will include shielded-arc welding of Class 1 vessels, resistance welding of pressure vessels, shop set-up for prefabrication, and welding in the shipbuilding and aircraft industries.

Several papers will deal with automatic electric control of welding processes, and one will discuss the effects of motor reactions in electric welding.

A description of a process for welding under water with the electric arc will draw a great amount of attention. Other topics include the thermit welding of rails under traffic, welding tubing by the atomic-hydrogen method, and pressure regulators.

The official program of the meeting will be published in full in the September issue of *The Welding Engineer.*

Welds Hold When Balloon Gondola Strikes Ground

One who examined the metallic gondola after its impact with the ground, a few minutes following the take-off of the stratospheric balloon from Soldiers Field, Chicago, on August 4th reports that although the gondola was damaged by striking the edge of a concrete base with a sharp blow, the welds held intact and no fracture was apparent along the seams. The damage was limited to a small area of the shell.

Meeting in Detroit on Welded Dies and Fixtures

The American Society of Tool Engineers, 8316 Woodward Ave., Detroit, Mich., announces a meeting to be held at 8 p.m., Sept. 14th, on the subject of welded steel dies, fixtures, and machines. A dinner will precede the meeting. Speakers and equipment for demonstrations will be furnished by the Whitehead & Kales Manufacturing Co., Weldit Acetylene Co., and Westinghouse Electric & Manufacturing Co.

The NRA Agreement . . .

as it affects the Job Welding Shop and other Industrial Establishments

IN ORDER that employers can display the NRA emblem, it is required that they sign the *accepted* Code of Fair Competition pertaining to their particular industry, or, if no code has yet been accepted by the Recovery Administration, they are asked to sign the so-called blanket code or "President's Reemployment Agreement" and also the "Certificate of Compliance."

Though many industries have submitted codes of their own, some of which have been accepted by the Recovery Administration, none of these covers the job welding shop. To display the NRA emblem, therefore, the job welding shop must sign the "Agreement" and the "Certificate," copies of which can be obtained from any U. S. mail carrier or postoffice. Those portions of the "Agreement" that will particularly affect the job shop and other industrial establishments are:

Requirements Affecting Hours and Wages

1. No person under 16 years of age shall be employed in manufacturing or mechanical industries.

2. No factory or mechanical worker or artisan is to be employed more than a maximum week of 35 hours nor more than 8 hours in any one day, but may work a maximum week of 40 hours for any 6 weeks within the period the "Agreement" is in force (August 1 to December 31, 1933).

3. The class of employe referred to above shall be paid not less than the following minimum wage:

Population of City	Minimum Weekly Wage
Over 500,000	$15.00
250,000-500,000	14.50
2,500-250,000	14.00

In towns of less than 2,500 population, all wages must be increased by 20%, provided this does not require wages in excess of $12.00 per week.

If the employe is paid by the hour, he shall receive not less than 40 cents per hour, or, if the hourly rate for the same class of work on July 15, 1929, was less than 40 cents per hour, he shall be paid not less than that hourly rate and in any event not less than 30 cents per hour.

Compensation for employment now in excess of the minimum wage shall not be reduced even though the hours of work be reduced, but the pay for such employment shall be increased by an equitable readjustment.

4. Prices of merchandise shall be held at as low a level as is consistent with the spirit of the NIRA.

5. Fullest cooperation shall be given in having a Code of Fair Competition submitted by the industry at the earliest possible date, and in any event before September 1, 1933.

Exemptions

Certain exemptions are allowed to the above provisions. The provisions regarding maximum hours do not apply to employes in establishments employing not more than two persons in towns of less than 2,500 population, which towns are not part of a larger trade area; nor to employes in a managerial or executive capacity who now receive more than $35.00 per week; nor to employes on emergency maintenance and repair work; nor to very special cases involving highly skilled workers on continuous processes where restriction of hours would unavoidably reduce production, but in such special cases at least time and one-third shall be paid for hours worked in excess of the maximum.

Where because of peculiar circumstances any provision in this Agreement would create great and unavoidable hardship, any person may obtain the benefits of the Agreement by signing it and putting it into effect and then, in a petition approved by a representative trade association of his industry, or other representative organization designated by the NRA, may apply for a stay of such provision pending a summary investigation by the NRA, with the understanding that he will abide by the decision of such investigation.

Population Figures

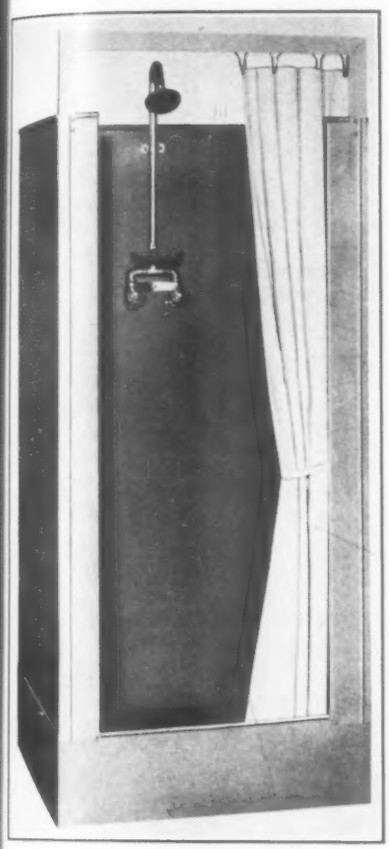
All population figures in the Agreement refer to the 1930 federal census. For towns or cities within a larger trade area, the population of the largest city in that area, and not of the specific town or city, shall be used to establish the minimum wage. For example, establishments in cities and towns within the trade area of St. Louis must employ the same minimum wage as St. Louis establishments.

The above digest of the Agreement is not intended to be complete but summarizes those paragraphs in which industrial establishments will be especially interested. More detailed information can be obtained from reading the Agreement or by consulting the National Recovery Administration, which maintains offices in Washington, D. C., and in the principal cities of the United States.

Welded and Soldered Base for Shower Cabinet

Welding and soldering is being used by the Joseph Turk Manufacturing Co., Bradley, Ill., in the manufacture of the base of every "Columbia Showerette," one of which is illustrated complete. This "Showerette" is a portable cabinet that is easily knocked down for shipment and is quickly and easily erected.

The walls and bottom forming the



View of "Columbia Showerette."

base are of 14-gage material and are spot welded to an L-shaped piece of 20-gage material which conforms to the contour of the base, this L-shaped piece serving the purpose of a shelf angle to the outstanding leg of which is welded the bottom sheet. The bottom and the angle are spotwelded first, and then the down leg of the angle is spot welded to the side walls of the basin. Lead is used as a filler around the edge of the bottom sheet to prevent leaks. This lead is flowed into the joints by means of a small carbon electrode.

These basins have been tested by dropping them from a height of 30 ft. so they land on a corner. They will bend, but they seldom crack or break open.

This design is used rather then to flange the edges of the floor and then spot weld to the sides, since the 20-gage material used for an angle is scrap and is easily formed.

Book Reviews

STANDARDS AND SPECIFICATIONS FOR METALS AND METAL PRODUCTS. Compiled by the Bureau of Standards, U. S. Department of Commerce. 7¾x10⅝ in.; 1359 pages; 1100 illustrations and 1700 tables. Cloth binding; price, $3.00. Copies may be obtained from the Superintendent of Documents, Government Printing Office, Washington, D. C.

This is the third volume of the "Encyclopedia of Specifications," the first two of which pertain to the wood-using industries and nonmetallic minerals. In this book there is reproduced the actual text of all nationally recognized standards and specifications for metals and metal products. For example, in the matter of welding rods and wire, specifications of the American Bureau of Welding, American Railway Association, Federal Specifications Board, American Electric Railway Engineering Association, and Society of Automotive Engineers are given.

The scope of this book is very broad, even covering such subjects as methods of testing and of making chemical analyses, metallic coatings, heat-treatment, and definitions of terms. A comprehensive index is included. Those engaged in the working or fabrication of metals or metal products will find this volume valuable as a reference work.

HANDBOOK FOR OXYACETYLENE WELDERS. 5x7¼ in.; 250 pages; 90 illustrations. Cloth binding. Published by the British Oxygen Co., Ltd., Angel Road, Upper Edmonton, N18, London, England.

This book takes up both high- and low-pressure systems of welding and equipment used. In the application of the process, the preparation of the work and manipulation of the blowpipe are explained. The problem of expansion and contraction is discussed at some length. The physical properties of metals are compared, and instructions are given for welding various metals and alloys. A chapter is devoted to the cutting of mild steel and cast iron, and the concluding chapter is given over to an explanation of the air-acetylene process for brazing, soldering, joint-wiping, etc. Tables of value to the welder are included. Considerable emphasis is laid on the need for following safe practices, and the appendix gives a list of safety measures applicable to the oxyacetylene process.

PROCEEDINGS OF THE INSTITUTION OF WELDING ENGINEERS—September-December, 1932. 5¼x8 in.; 229 pages; 81 illustrations. Board binding. Published by The Institution of Welding Engineers Ltd., 30, Red Lion Square, London, W. C. 1, England.

Among the papers, with discussions, included in this volume are the following: The Testing of Fusion Welding in the Laboratory; The Radiographic Examination of Welds; Cutting Steel With Oxygen Machines; Eye Protection in Welding Operations; Atomic-Hydrogen Arc Welding and Its Applications; The Essentials of Good Welding. These papers were read before the Institution at its meetings in London, Manchester, and Birmingham.

A WELDED BRIDGE TRUSS. By Richard E. Burt. 6x9 in., 20 pages; 8 diagrams. Paper binding. Published by the Rensselaer Polytechnic Institute, Troy, N. Y.

In this thesis on the design of an all-welded railroad bridge, the author selected the Warren-truss type of bridge with sub-verticals because of its short panel lengths and general adaptability to modern practice. The design involves a simple truss bridge, site unknown, for a single tangent track. The project includes the design of all component parts of the truss system, the floor system, wind and lateral bracing, splices, pedestals, and their connections.

INDEX TO A. S. T. M. STANDARDS AND TENTATIVE STANDARDS. 6x9 in.; 119 pages. Paper binding. Published by the American Society for Testing Materials, 1315 Spruce St., Philadelphia, Pa.

The 441 A.S.T.M. standards and 226 tentative standards in effect as of October, 1932, are indexed in this pamphlet under appropriate key words according to the materials or subjects to which they apply. Under the subject head "Welding" are listed 13 specifications and 7 tentative specifications, together with volume references to the publications in which they appear. These cover boiler and firebox steel, boiler tubes, chain, steel pipe, plates, reinforcing wire, structural steel, and wrought-iron pipe.

PROCEEDINGS OF TWENTIETH ANNUAL MEETING OF THE C.G.M.A. 6x9 in., 92 pages. Paper binding. Published by the Compressed Gas Manufacturers' Association, 110 West 40th St., New York, N. Y.

Reports of officers and committees are included, as well as the papers read at the 20th annual meeting. Among the papers included are those carrying the following titles: Oxygen and Acetylene Utilization by Other Industries; The Trend of Power Costs; What's Ahead for the Compressed Gas Industries?

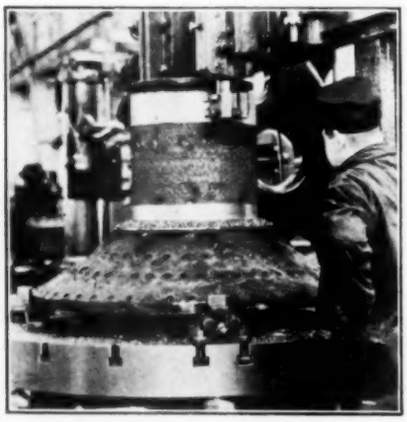
BACON'S PUBLICITY MANUAL. 8½x11 in., 88 pages. Cloth binding; price, $3.00. Published by R. H. Bacon & Co., 608 S. Dearborn St., Chicago, Ill.

This is an instruction manual on the preparation of publicity material of an editorial nature for industrial and business publications. A directory of 1600 such publications is included, classified according to markets. This is the first time a comprehensive manual has been prepared on editorial publicity. Advertising departments and advertising agencies will find the book of great value as a reference work.

Reduces Warehouse Stocks by Welded Repairs

By reconditioning mill equipment by means of arc welding the Anaconda Copper Mining Co., Anaconda, Mont., have reduced their warehouse stock necessary to insure continuous operation of mill machinery and, in addition, have saved considerable money by minimizing the necessity for purchasing new parts. Recently, a badly worn ball-mill trunion was brought into the company's welding shop for reconditioning. This particular trunnion was 20 in. in diameter, 30 in. long, and weighed approximately 1½ tons. To replace it with a new trunnion would have cost in the neighborhood of $300.

The company had rebuilt an old boring mill for use in reconditioning work. After the worn trunnion had been built up to a diameter of 21 in. by the deposition of 300 lb. of welding electrode, it was placed on this boring mill and machined down to a finished diameter of 20 in. A General Electric automatic arc-welding head



Machining a Ball-Mill Trunion Built Up by Welding.

and General Electric type F electrodes were used on the job. The total cost of reconditioning the trunnion, including power, labor, electrodes, and overhead, was approximately $75. Since its repair, the trunnion has given excellent service.

National Metal Exposition Arouses High Interest

The largest National Metal Exposition since 1929 is assured by the large number of contracts for space that have been received for the Detroit show, which opens in Convention Hall on October 2nd. This will be the 15th annual exhibition of this sort. Among the societies participating in the National Metal Congress during the week of October 2nd are the American Welding Society, the American Society for Steel Treating, the American Institute of Mining and Metallurgical Engineers, and the Wire Association. Information on the American Welding Society meeting is given elsewhere in this issue.

Get "*H. O. T.*" on Welding

■ Edited by
H. O. T. RIDLON
Welding Consultant, Joliet, Ill.

[This section is dedicated to Better Welding and Better Welding Shops. Suggestions and criticisms are invited.]

Making a Preheating Furnace

Preheating ovens are something some of my good friends have asked a lot about. I have always favored charcoal as a preheat fuel because of its clean, even heat. Of course, your own shop and the type of work you run into determine to a great extent the type of preheat furnace to build. Usually the most satisfactory method for general job-shop practice is to pick the corner of the shop least used and free from drafts. Cut out a space in the floor about 8x8 ft. or 10x10 ft., placing firebricks on edge close together. Sometimes building up 18 in. to 2 ft. is very convenient. Have sufficient firebrick so as to build a temporary furnace suitable to each job being done. Don't forget to have an air hole around the bottom of your temporary structure. Also be sure to have ample room around your firebrick base to work in and to move the casting about conveniently. A traveling chain hoist above your preheat oven will come in very handy. But you'll have to use your own judgment, depending upon your own shop and working conditions. Kerosene preheaters are good because their heat is fast. The kerosene preheater with compressed air that atomizes the kerosene very finely, is the most satisfactory type, as it gives a cleaner flame condition.

* * *

Thar's Gold in Them Thar Scrap Piles

Scrambling through scrap piles and pulling out things that have been thrown away as being completely worn out, taking them back to the shop, reclaiming them, and then presenting them to their original owner, is real sport to me. I sure get a great bounce out of it and usually make myself a darn good friend, and an honest nickel or two. You'll find so darn much that you'll turn your own corner, and, before you know it, you're going places and making money! Yes sir, profit.

* * *

World's Fair Notes

I've done some talking about the welding that was done at the World's Fair in Chicago. Really, justice can't be done in these short lines, and I repeat—go give it a good look yourself, for I'm sure you'll see much to interest you if you're in the welding game.

Got a swell bounce out of the steam engines there of the grand old vintage of 1882, that I was looking over a week or so ago. There was a sort of apron made of ¼-in. plate. It was a swell cutting job and nicely welded. But history teaches, I believe, that the first oxygen regulator was made in 1906 or 1907. It reminded me of the 10,000 or more "original" welders that I have met personally. This certainly is a Century of Progress, and I suggest some of you old timers had better keep an eye on these youngsters—they may have a good trick or two up their sleeves.

* * *

The Day of Competition Is Still Here

Speaking of tricks, I've heard lately a number of the old boys squawking because some young competitor down the street had gone nertz and was cutting prices so that they both were starving to death. Not that I like the appearance of starving welders, but because I believe there is a reason for everything, I've called on said competitor. And usually found that he had modern equipment, was something of a salesman, went out after paying jobs and learned what hard-facing was all about. That's why some of these starving youngsters, who cut prices, can do it, and yet look pretty darn well fed. Not that they are fat, 'cause most of 'em are darn busy these days. And Mister, these are happy days for the really progressive welding shop owner who goes out and sells his services, for people are having everything repaired instead of buying new in spite of what Gen. Hugh Johnson tells 'em to do.

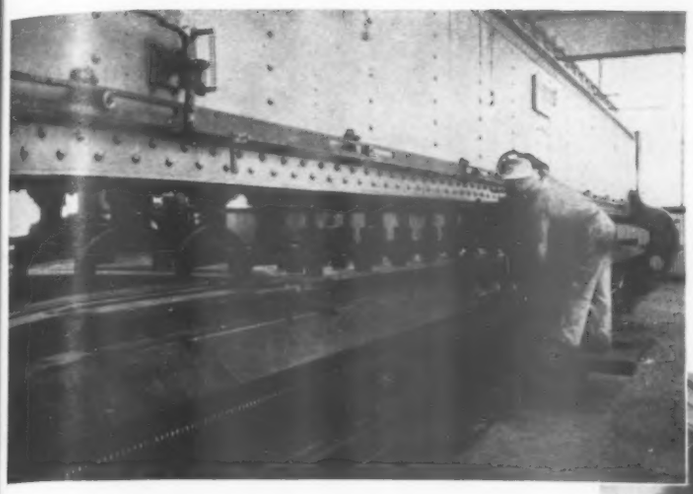
* * *

Want Some Dope on Hard-Facing Farm Machinery?

The world marches on! The welding shop has a new and larger prospective field, particularly in the rural districts. In the past, manufacturers of farm machinery have used bolts and rivets so that Mr. Farmer could repair most of his own equipment. Now they are rapidly turning to welded construction, which means the farmer will become welded-minded and will have to have the repairs done in the welding shop. So get busy and make a bid for that business, you real shop owners. Would you readers like to have me talk about hard-facing as applicable to farm machinery in some future issue? Write me c/o Barrett Hardware Co., Joliet, Ill.

Welding Pipe for Boulder Dam

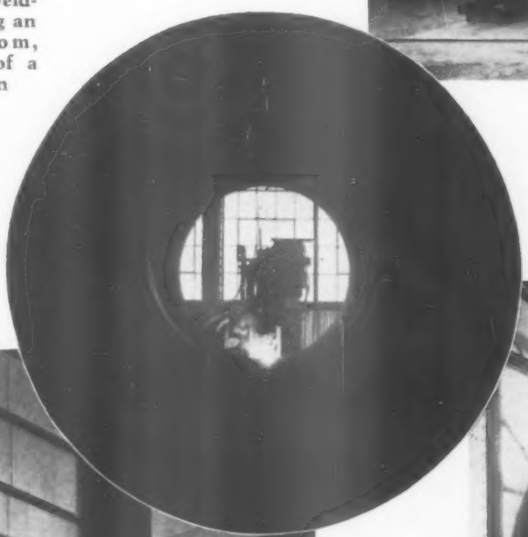
● Views in the Field Fabricating Plant of The Babcock & Wilcox Company at Boulder Dam.

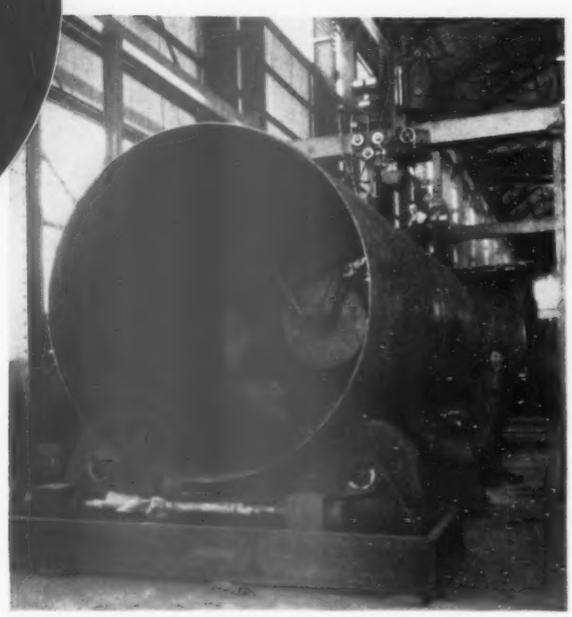


This huge machine has a 40-ft. bed, and planes and bevels the edges of the plates preparatory to welding.

Approximately 400,000 linear feet of welding is being performed in the fabrication of steel pipes ranging in diameter up to 30 ft. and made from plate in thicknesses up to 2¾ in. The General Electric X-Ray machine shown will be used to inspect all welds.

Automatic arc welding machine laying an inside, or bottom, bead in a seam of a pipe 8½ ft. in diameter.





Preparatory to welding the girth seam, the sections of pipe are butted together and held in alignment by a spider which also acts as a backing member for welding.

After the plate is formed, the longitudinal seam is welded with an automatic machine. An end piece specimen tack welded to one end of the seam is welded at the same time as the seam and then tested to determine the quality of the weld.

· E D I T O R I A L ·

Read This, Then Write Your Own Moral

● This is a true story, except that a fictitious name is given for one of the towns. A salesman for a welding supply company calling on a blacksmith shop in Cherryvale, Ind., was told by the proprietor that the farmers thereabouts wouldn't buy hard-facing, and therefore he had no use for such rods. The salesman proceeded to Crown Point, a few miles away, and there he sold some hard-facing rods to a welding shop, the owner of which reported that two farmers from near Cherryvale were coming in to have their plows hard-faced.

Reducing the Danger of the Spinning Basket

● Designers of machinery will perform a needed service to their fellowmen when they substitute rolled steel in place of castings as rotating parts for such machines as centrifuges and centrifugal dryers. A part which rotates at high speed, made up of plate and rolled shapes welded together, requires a much less powerful motor or engine to bring it up to speed in a given time than would the same part made as a casting, this being the result of the lighter weight of the welded piece. If the rotating piece is started and stopped frequently, considerable power is saved by the lighter construction. From the standpoint of safety, the welded piece has a great advantage. The total stresses produced in the welded piece are much less than those in a casting made for the same purpose, and the stored up energy at rated speed is greatly reduced over that represented by a rotating casting. Hence, an "explosion" or shattering of the parts, caused by a flaw in the material or improper design or a "running away" of the driving unit, is much less dangerous to life and property in the case of the lighter rotor, and flying pieces may remain confined in the housing of the machine. This very succinct letter bearing on this subject was recently received by the Chemical Section of the National Safety Council and appears in their News Letter: "You might be interested in knowing that we have broken a 17-year-or-thereabouts record for no serious accidents and have had an accidental death in our plant. One of our chemical centrifuges flew apart and parts of the casting struck the workman, killing him. I really believe the centrifuge companies should build their machines so that such accidents would not happen. It seems that the side casting was cast iron (instead of unbreakable boiler plate or steel thereby making the machine that much stronger; and should a centrifuge basket fly to bits, it would be contained inside the centrifuge, perhaps wrecking it but saving the life of the operator). Such things as these, a purchaser of a centrifuge does not take into consideration until he learns, as we did, the weakness of such machinery." Wherever high rotative speed is desired but concentrated weight is not required, the welded basket or rotor made of sheets or rolled sections should be employed as a matter of safety and economy. The makers of centrifuges do not have to "sell" the writer of the letter quoted above on welded equipment; all they have to do is make it, since the advantages are already obvious to him.

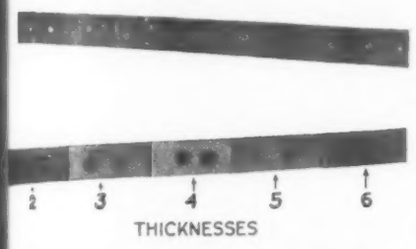
We'll See You at Detroit

● Detroit will be the Mecca for all branches of the metal industry the week of October 2nd. With good programs in prospect by the American Welding Society, the American Society for Steel Treating, the Wire Association, and other societies, and with the National Metal Exposition holding forth in the city that week, the public, the visitors, and the exhibitors will learn of new developments in metals and new applications of metals. There is more need at this time for keeping informed on what is going on in the metal field than at any time in the past five years. In the first place, the index of industrial activity is steadily rising and prices are going up. This is the crucial period in the life of many concerns. What they do at this time will determine in large measure their state of well-being five years hence. Moreover, Detroit being the center of the automobile industry, who will be expending huge sums for equipment during the next several years, it offers the visitor an opportunity to know the needs of that industry and to learn the lesson of how, through persistent development of product and use of efficient machinery and processes to reduce costs and improve the product, it can give the buyer to-day by far the greatest value the industry has ever offered. The rapid growth and prosperity of the automobile industry can be duplicated in several other industries if they would get the same vision. There are ideas which will come out of Detroit during National Metal Week that will bolster the mounting payrolls of our industries, that will put more men to work, and that will make fortunes for certain individuals who will grasp them. Every individual connected with welding or with any other part of the metal industry can ill afford to be absent from Detroit the first week in October. Let's go prepared to enjoy ourselves, to learn from the experiences of others in the field, and to pass on information which we have that is vital or important to our industry.

New Equipment

Automatic Timer Insures Good Spot Welds

For use in connection with resistance-welding machines, the EC&M Automatic Weld Timer has been developed by The Electric Controller & Manufacturing Co., 2690 East 79th St., Cleveland, Ohio. Instead of providing a definite amount of time for each weld, this device varies the time automatically in inverse proportion to the rate of current flow. Hence if the voltage is low or the material is dirty or scaly, the current remains "on" for a longer time than if the voltage were normal or the material were clean, and thus the likelihood of obtaining poor welds is materially reduced.



Without Change in Timer Adjustment, 2 to 6 Pieces of Steel Are Welded Together.

With this equipment installed and adjusted for the range of work at hand, it is claimed that every weld will be sound and all welds will be uniform regardless of fluctuations in the line voltage, or condition of electrodes or of the surface of the material, or variations in the thickness of the material. Thus it is possible to obtain satisfactory welds with ordinary black sheets instead of using the more expensive finished sheets.

Removal of Bottom Strip Shows Good Welds Throughout.

Adjustment of the timer is made by test, using a few scrap pieces of the work to be done. When the desired weld is obtained, the cabinet door of the timer may be locked; and for all practical purposes, within reasonable limitations, it will not be necessary to readjust the timer, the last weld made at the end of the day's run being practically the same as the first weld. For the exceptional case, however, the adjusting dial on the weld timer can be changed to suit the particular condition.

The illustrations show the top and bottom views of a welded section consisting of 2, 3, 4, 5 and 6 thicknesses and a view with the bottom strip removed. The welds were made without change in the adjustment of the timer. The color rings of all welds are uniform, and the removal of all strips one by one shows that sound welds are made on the inner as well as outer strips.

The EC&M timer consists of a rectifier tube which charges a fixed condenser in proportion to the rate of current flowing in the welding circuit. When the charge reaches an amount sufficient to pass current through two neon-gas-filled tubes, a small relay operates and opens a second relay controlling the main-line contactor. The tubes are in the circuit only when the welding current is "on," so that as soon as the main welding circuit is opened, the weld timer is ready for the next operation.

Various other forms of weld timers are supplied where required. One is the automatic repeat type, which has an additional timing element to govern the length of time the electrodes are apart. Another style, known as the non-beatable type, prevents the operator from separating the electrodes from the work before the welding current has been interrupted.

New Line of Gas Regulators

A line of gas regulators, in single-gage and two-gage designs, has been announced by the Gasweld Equipment Co., 625 Jackson Blvd., Chicago, Ill. These regulators have a self-centering, adjustable seat and the diaphragm can be furnished in either metal or rubber. They are built of heavy cast-brass material, with a full bridge, and are said to maintain a constant, steady pressure.

System for Recording Welding Time

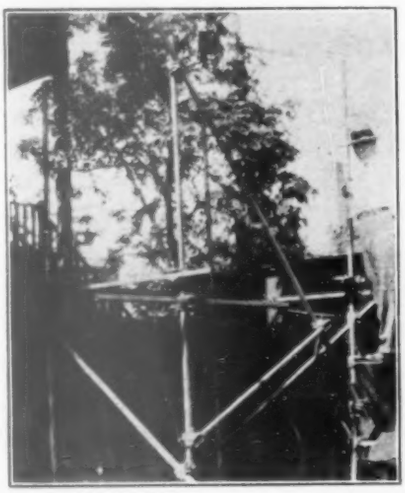
A device for automatically recording the welding time in hours of each arc-welding operation, as well as elapsed time between operations, is being manufactured and marketed by the firm of Robert E. Kinkead, Inc., 3441 Lee Road, Cleveland, Ohio. Each unit consists of five time dials and a master clock and will take care of five separate welding circuits. When the arc is struck on any circuit, the corresponding time dial or cost clock lights up and the clock begins to record the welding time. When the welding arc is broken, either by short-circuiting the electrode or by withdrawing the electrode from the work, the dial ceases recording.

This time-recording system is a valuable adjunct to a shop's cost system. It makes it easier to compute costs and increases the accuracy of cost figures. It also enables the management to eliminate lost motion in general, by indicating the actual welding time and the "lost" time. Lack of handling equipment, lack of system, distractions, and other causes of "lost" time can be more easily ferreted out. This system also makes it possible to eliminate piece work. Mr. Kinkead, a well known authority on welding, is installing this system temporarily in plants to show its merits.

Time Recorder for 5 Welding Circuits.

New Type of Clamp Has Many Uses

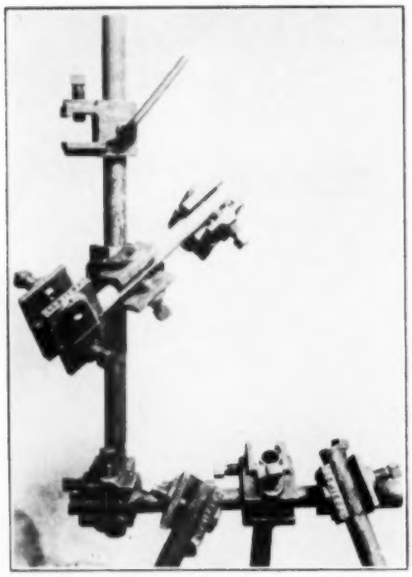
The erection of steel scaffolding and other framework is greatly simplified by using double clamps such as those illustrated. These clamps can also conveniently be used in the shop or in the field for holding rolled steel shapes in their proper position for welding. They will take squares or rounds or they can be used to grip the flanges of standard steel sections.



Scaffolding Being Erected With Clamps.

Several types of clamps are available. One, it will be noticed, is of one-piece construction so designed as to hold two members at right angles to each other. Another type is made in two pieces, joined together with a swivel attachment, and when attached to one member can hold the other member at any desired angle.

These clamps have almost unlimited possibilities in construction work. By means of them it is possible to make a rig for erecting a steel structure with its own materials. In welded construction, parts can be lined up without using holes, preparatory to striking the arc. A steel-cable sheave or a pulley block may be used in connection with these devices for drawing parts together or pulling structural members into their proper position with relation to other members.



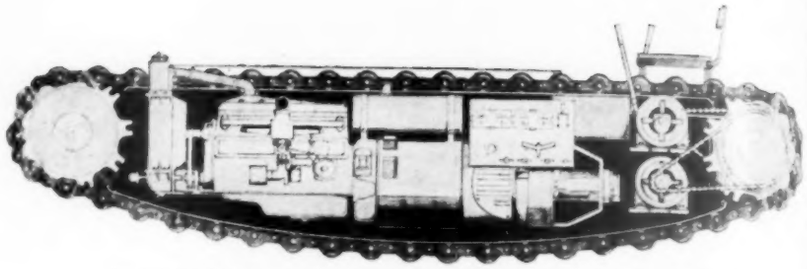
Illustrating Versatility of New Clamp.

These clamps are made and marketed by F. Le Mieux, 1542 W. Jackson Blvd., Chicago, Ill.

Manufactures Trailers of All-Welded Design

Two-wheeled all-welded trailers with pneumatic tires are now being manufactured by the Pioneer Welding & Manufacturing Co., 618 E. Michigan Ave., Kalamazoo, Mich., of which J. E. Rork is proprietor. The standard trailer has a box 4x5 ft. in size which will hold about two-thirds of a cubic yard. However, the size can be readily altered to suit the requirements of the purchaser.

This company for years has been furnishing many of the manufacturers of oxyacetylene equipment with two-wheeled trucks for carrying oxygen and acetylene cylinders. They have now added to this line a truck with solid rubber tires, claiming that the tires absorb most of the shocks when the equipment is moved and save much wear and tear on the regulator parts and gages.



The New Schramm "Trac-Weld" Welder Lays Its Own Track.

Self-Propelled Arc Welder of Tank-Crawler Type

Its ease of mobility over rough, uneven ground and railroad tracks makes the new Schramm "Trac-Weld" welder especially adaptable for railroad maintenance, pipeline work, shipyard and dry-dock work, and on large construction jobs.

This new welder is self-propelled, being driven by a heavy-duty Buda engine, and is of the tank-crawler type, resulting in a low center of gravity. It is equipped with a 300-ampere G-E arc welder of either the single-arc or double-arc type. The complete unit is 30 in. wide and 40 in. high, and the single-arc machine has a length of 14 ft. and the double-arc a length of 17 ft. It is also provided with a 7½-kw. tool generator, which operates two reversible electric motors for driving the treads.

The machine has an average speed of 1 to 1½ miles per hour, either in forward or reverse, and it can turn around in its own length. The driver's seat is located with due regard to the comfort of the driver. Two levers, one on each side of the driver, control the speed and steering.

This unit is manufactured by Schramm, Inc., of West Chester, Pa.

Holding Plates in Position for Welding

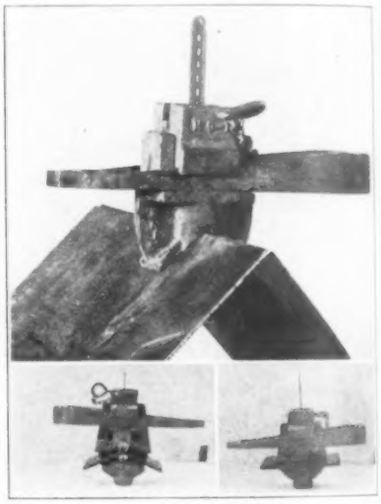
Welding clamps designed to facilitate the assembly of work for welding, have been developed and placed on the market by The E. G. Todt Co., 9388 Ewing Ave., South Chicago, Ill. These clamps, or jigs, are used to hold plates or other similar material temporarily together so that a box, tank, or other form can be fully erected, its seams tacked or lightly welded between the clamps, the clamps removed, and the welding completed.

Each clamp consists of two jaw members to one of which is attached a crosshead block which can be forced apart from the jaw by means of a slotted wedge located between the block and the jaw. To the other jaw is attached a strap which extends up through the assembly consisting of the other jaw, wedge and block and is provided with holes located at various distances from the end of the strap through which is inserted a pin.

With plates inserted between the jaws, the jaws are tightened by driving the wedge, which moves one jaw toward the other. Thus the plates are held rigid. After the plates are tacked together, the clamp is readily removed by loosening the wedge and withdrawing the pin, which allows the lower jaw member and strap to be withdrawn.

The jaws can be designed to hold the plates in abutting alignment or at right angles to each other. One wedge is of the universal type, in which the jaws are provided with movable grips, allowing the plates to be held at odd angles one with the other.

These clamps enable the work to be set up quickly and accurately by any helper independently of the welder, thus reducing idle time or eliminating it altogether.



Clamping Plates Together for Making Corner and Butt Welds.

Welding Spectacles With Wide Lens

A new type of welding spectacles and new lens have been announced by The Linde Air Products Co., 30 East 42nd St., New York, N. Y. The lenses are mounted in a canvas-bakelite frame, and are 50 mm. in diameter. The bows are covered with insulating material, and the frame is said to be non-flammable and highly resistant to the conduction of heat. A snap device allows the frame to be spread and the lenses quickly changed. The new lens (Type AA) is flat-ground and polished and made in light, medium, and dark-green shades. It is said to conform to all code requirements, including those of the federal government.

Patents Issued

Compiled by Patent & Technical Information Service, 1336 New York Ave., N. W., Washington, D. C.

Atomic-Gas Torch. 1,911,033. Boris Vasley Nagashev, Lynn, Mass. Assignor to General Electric Co., Schenectady, N. Y.

Welding Rod. 1,911,053. Gerald R. Brophy, Schenectady, N. Y. Assignor to General Electric Co., Schenectady, New York. Comprising an iron alloy containing less than 0.05% carbon, 2% to 5% manganese, and an appreciable amount but less than 1% of metal of the group constituted by the elements silicon and titanium.

Arc-Welding Electrode. 1,911,054. Gerald R. Brophy, Schenectady, N. Y. Assignor to General Electric Co., Schenectady, New York. Has a coating containing cellulose with an appreciable ammonia content.

Method of and Apparatus for Electric Welding. 1,911,059. Charles A. Cadwell, Cleveland Heights, Ohio. Assignor to The Electric Railway Improvement Co., Cleveland, Ohio. Combining a heat-distributing plate adapted to contact with the surface to be heated, means for directing an arc against said plate, and means for spreading such arc over the surface of said plate, said means including an electro-magnetic coil disposed with its axis substantially normal to such arc, and a core for said coil.

Process for the Manufacture of Fusible Electrodes for Electric Arc Welding of Aluminum and the Like Having a Saline Coating. 1,911,886. Ferdinand De Pape, Brussels, Belgium. Assignor to La Soudure Electrique Autogene, Ste. Ame, Brussels, Belgium. A process for making fusible electrodes for the electric-arc welding of aluminum and the like, in which the electrodes are coated with a composition obtained in particular by treating a saline mixture with a compound of acid character capable of forming by reaction or coagulation a gelatinous precipitate and subsequently fixing the reaction or coagulation mixture by adding a compound of alkaline character which effects simultaneously a peptization to produce a viscous paste, and comprising further the steps of treating the coated and dried electrode containing alkaline carbonate formed from the carbon dioxide of the air, with a compound which displaces the carbon dioxide and which combines with the alkali.

Welding Process. 1,912,901. Howard J. Kerr, Westfield, N. J., assignor to The Babcock & Wilcox Co., Bayonne, N. J. Method comprises making notches at spaced intervals in the edges of a sheet of metal, bending the sheet until the edges are brought into proximity to each other, inserting a strip of metal between the edges, passing an electric current through the edges and strip, and pressing the strip into place after the desired temperature has been reached.

Electrode or Rod for Welding. 1,912,968. Harry Bull and Lawrence Johnson, Sheffield, England, assignors of one-third to John Herbert Aitchison, Sheffield, England. Method of making a welding rod, for welding a ferrous alloy, by providing a hollow billet in which at least two of the metals in the alloy to be welded are alloyed, by lining the hollow of the billet with another of the alloy metals applied by electrodeposition, by filling the lined hollow with the remainder of the alloy metals to form a composite billet, and by working the composite billet into a composite welding rod in an elongating process.

Resistance-Welding Machine. 1,913,029. Henry S. Holmes, New York, N. Y., assignor, by mesne assignments, to Metropolitan Engineering Co., New York, N. Y.

Method and Apparatus for Producing Welded Articles. 1,913,322. James L. Adams, Jr., Youngstown, Ohio, assignor to The Youngstown Sheet & Tube Co., Youngstown, Ohio. A seam welding apparatus, comprising a pulsating-current supply and a means for abrading the seams. The abrading device is synchronized with the pulsating current, and after the seams are heated and abraded, welding pressure is applied.

Material for Welding Wrought Aluminum Alloys. 1,913,394. Edwin Joyce, Upper Darby, Pa. A welding material having substantially the following composition: aluminum, 92½%; copper, 4% to 5%; silicon, 1.20%; zinc, 0.25%; iron, 1.20%; magnesium, 0.25%; manganese, trace.

Electric Welding Machine. 1,913,713. George A. Lutz, Cranford, N. J., assignor to American Circular Loom Co., Inc., Dover, Del.

Ferrule for Electric Welding. 1,913,714. George A. Lutz, Cranford, N. J., assignor to American Circular Loom Co., Inc , Dover, Del.

Welding Apparatus. 1,914,518. Charles Warren Martin, Huntington Park, Calif.

Joining Metal Parts, Including Tubes. 1,914,811. Herman L. Kraeft, Cleveland, Ohio, assignor to Murray-Ohio Manufacturing Co., Cleveland, Ohio. Method of welding to form a joint between a metal tube and one end of a cooperating transverse frame member.

Cope for Rail Welding Molds and Method of Forming the Same. 1,914,878. Edward F. Begtrup, Jersey City, N. J. In the method of alumino-thermically welding rail ends, enclosing the rail ends in a sectional mold extending to substantially the level of the rail treads, and forming the cope section of the mold *in situ* prior to preheating by compacting the refractory material of the cope section against the top surface of the rails in a frame supported at the top of the sectional mold and the tops of the rail ends.

Process of Soldering and Annealing. 1,914,881. William J. Buehring, Chicago, Ill. Method of making a wire clamp, consisting in temporarily connecting the supporting loop thereof to one of the clamping elements, applying solder to this connection, and simultaneously subjecting the connection and a portion of the loop to sufficient amounts of heat to melt the solder and to anneal the portion of the loop.

Method of Electric Welding. 1,915,047. Doraf W. Blakeslee, Pittsburgh, Pa. A method of electrically welding tubing, which comprises preforming the tube with overlapped longitudinal seam, relatively moving the tube through an alternating magnetic field to cause electric current to be induced therein and flow across the unwelded seam of the tubing, spreading the overlapped edges of the tube at a point in advance of the magnetic field, whereby the edges are disposed in angular relation when entering the field, applying pressure to the edges of the tubing to move them into a common plane, and causing the edges to move into abutting engagement with each other at a point within the field by the resiliency of the tubing.

Method of and Apparatus for Electric Welding. 1,915,082. Doraf W. Blakeslee, Pittsburgh, Pa. A method of uniting the edges of metal members, which comprises inducing current flow across the edges by means of an a.c. coil disposed at one side of the members and causing relative traveling movement of the coil and the members, and supplementing the current flow induced by the first-named coil by a second coil disposed at the opposite side of the members, the second coil being positioned in such radially offset but overlapping relation to the first coil at the beginning of the welding operation as will effect concentration of the induced current flow in the members, softening the metal of the said edges, and thereafter moving the second-named coil to lengthen the circuit of induced current.

Electric Welding Apparatus. 1,915,639. Herbert A. Woofter, Detroit, Mich., assignor to Swift Electric Welder Co., Detroit, Mich.

Apparatus for Use in Electric Spot-Welding. 1,915,846. Robert Davidson Bell, Dundee, Angus, Scotland.

Trade Literature

Arc-welding sets, accessories and clothing are covered in two bulletins issued by the Universal Power Corp., 1719 Clarkstone Road, Cleveland, Ohio. Bulletin 1056 describes shunt-inductor motor-generator welding sets, and Bulletin 1057 deals with arc-welding accessories and protective clothing.

Fixed-end connections (beams to columns) for arc-welded tier buildings is the subject of Plate 41 of "Studies in Structural Welding," issued by The Lincoln Electric Co., Cleveland, Ohio. Diagrams illustrate means of making fixed-end connections and show the direction of stresses in beams produced by loading. Examples are used to illustrate the calculation of size and length of fillet welds to withstand moments equal to the working strength of any beam.

The Verson Allsteel Junior power press brake is described in a leaflet issued by The Allsteel Press Co., Inc., 12015 S. Peoria St., Chicago, Ill. This press, which is of welded construction, has an overall height of 80 in., a capacity of 22 tons, and weighs 2100 lb. It is driven by a ¾-hp. motor.

A new Ryerson stock list, larger and more complete than any of the previous issues, has just been published by Joseph T. Ryerson & Son, Inc., Chicago, Ill. The new book has 232 pages and gives information and listings on welding rods and fluxes for various metals and alloys, as well as steel and various other metals and alloys in sheets and rolled shapes.

Hobart arc welders are described, and many applications are cited and illustrated as examples of how they are saving money for those who own them, in a

New Hobart Booklet.

new booklet entitled "The Many Profitable Uses of Simplified Arc Welding," copies of which can be obtained from Hobart Bros., Box U831, Troy, Ohio.

Commercial News

Harnischfeger Exhibit Creates High Interest

Demonstrations in arc welding and arc brazing are going on every day in the booth of the Harnischfeger Corp. in group No. 9, Travel and Transport Building, at Chicago's "A Century of Progress," where they are being viewed by many visitors to the Fair.

Constructed of various metals such as aluminum, copper, brass and steel, all welded together by means of the P&H-Hansen arc welder, this booth is attracting widespread attention. Even the stands of novel design located in the booth were cut out of plate by the torch and welded together with the arc.

A P&H-Hansen arc welder is set in a recess in the wall and supplies the current for the arc welding being done in the welding booth, in which various metals, including aluminum, are being welded by the arc. Of special interest is the P&H-Hansen electric torch, which

Demonstrating Welding and Brazing at the World's Fair.

also receives its current from the welding machine and which is being demonstrated in the joining of such metals as copper, brass and aluminum.

Tested specimens of welds are on display. There is also a P&H-Milwaukee hoist, as well as views of the P&H-Milwaukee barrel-pitching machine, developed more than 40 years ago and now modernized to meet the demands of present-day brewery requirements.

John Huntington Institute Starts Course in Fall

The next welding course given by the John Huntington Polytechnic Institute, Cleveland, Ohio, opens September 18th with a limited enrollment. The welding courses given by this school are receiving many favorable comments. The days are spent by the students at the plant of The Lincoln Electric Co., and the nights are given over to lectures at the school. Though the evening classes are scheduled to be over by 9 o'clock, interest runs so high that they seldom dismiss before 10 or 11 o'clock. The Institute recently moved to its new home at 3133 Euclid Ave. E. W. P. Smith is the welding instructor.

Offers New Kind of Weld Testing Service

To the manufacturer using welding in fabrication and to the buyer of welded products made according to specifications or codes, there is now available a testing service for making reports on testing processes and on weld specimens before and during construction to insure that specifications are being followed. This service is being offered by the Pittsburgh Testing Laboratory, Pittsburgh, Pa., through its newly created Welding Division known as the National Weld Testing Bureau. This new division is headed by James W. Owens, a well-known authority on weld testing and research.

In addition to the above services, the Bureau is also equipped to make laboratory tests of weld specimens, to inspect and report on welded products and structures, to investigate special welding problems, and to act in an advisory capacity.

The Bureau has issued a bulletin on its services in connection with reports on welding processes and on weld specimens. These services are designed to assist manufacturers, fabricators, contractors and firms or corporations to comply with specifications, codes, or other requirements, and to provide them with a means of satisfying purchasers of welded products, also to satisfy official inspectors that these requirements have been met in so far as they relate to the welding process and class of workmanship required.

The testing service offered by the Bureau will be standardized and authoritative and will be neutral as regards the

welding process, type of make of equipment, and the class of material (base or filler metal) sold or used by the client. This type of service will doubtless materially reduce the cost of weld testing in the case of many concerns, and should be of particular benefit to those desiring to enter the field of manufacture of equipment under existing codes and other regulations. With such supervision and testing, the likelihood of poor workmanship is reduced, and insurance companies will be interested in the effect on eliminating the "human factor," thereby encouraging the use of welding by architects and engineers and stimulating the use of welded structures and products.

By coordinating the tests called for in specifications, codes and rules governing welded construction and repairs, the Bureau expects to reduce the cost of welding to the client by avoiding repetition or duplication of tests, and also to furnish clients, if desired, with the base materials necessary for weld specimens as well as to prepare both weld and test specimens when the client lacks the required materials or machine tools.

Mr. Owens, director of the Bureau, has had 15 years' experience in the welding field and is in close contact with technical societies and code-making and regulatory bodies. He was a member of the Emergency Fleet Welding Committee during the World War, is a director of the American Welding Society, who awarded him the Miller Memorial Medal in 1929, was awarded the first prize in the first Lincoln arc-welding prize competition, in 1928, and is the author of "Fundamentals of Welding—Gas, Arc, and Thermit."

The Pratt-Brayman Co., of Bedford, Ohio, are introducing a new cast-iron brazing flux to the market.

John M. Mathews, secretary and sales manager of The Harris Calorific Co., Cleveland, Ohio, is vacationing in Central and South America.

Williams & Co., Inc., 901 Pennsylvania Ave., N. S., Pittsburgh, Pa., have been appointed distributors for the Babcock & Wilcox line of welding wire, it is reported.

C. E. Phillips & Co., 5443 Twelfth St., Detroit, Mich., have been appointed by the Metallizing Co. of America, Los Angeles, Calif., as distributors of their metal-spraying equipment in the Detroit territory.

The Allsteel Press Co., 12015 Peoria St., Chicago, Ill., pioneers in the application of welded steel plate construction to presses, has sold a 200-ton-capacity, straight-sided, double-crank, geared press of welded construction for export to Holland.

Ray Tarbell, a well-known figure in the welding field, has been appointed sales manager of the Welding Wire Division of the Babcock & Wilcox Co., of Barberton, Ohio, who are introducing a shielded-arc welding wire for which they recommend straight polarity.

Reg. K. Randall and Edward T. Scott, of the Cleveland School of Welding, have made alterations in the school and office and have redecorated the entire school. They are planning for extensive school activity this fall, and report that calls for welders through their employment service department have picked up noticeably.

The Wayne Welding & Supply Co., Fort Wayne, Ind., have been appointed distributors for the Champion "Red Devil" welding electrodes manufactured by the Champion Rivet Co., of Cleveland, Ohio, and for the line of acetylene generators manufactured by the Sight Feed Generator Co., West Alexandria, Ohio.

Robert Michels has disposed of his entire interest in the R. Michels Welding & Supply Co., 720 Washington St., Covington, Ky., and is retiring after 24 years in the welding and welding supply business, according to an announcement from Thos. W. Duffy, proprietor of the concern. The name of the company will remain unchanged.

The Harnischfeger Corp., Milwaukee, Wis., announce the following additions to their line of jobbers and distributors: George J. Meyers, 2900 McKinley Ave., Cincinnati, Ohio; Wm. J. Chesak, Modern Equipment Co., El Paso, Texas; Harron-Richard-McCone Co., 2205 Santa Fe Ave., Los Angeles, Calif.; and the J. E. Dilworth Co., 347 S. Front St., Memphis, Tenn.

The growing popularity of the welding school conducted by The Lincoln Electric Co., Cleveland, Ohio, is attested by the fact that at present there is a waiting list of applicants for the school, which is conducted in terms of four weeks each. The instructors are E. W. P. Smith and Art Madsen. It is reported that a more serious-minded and higher-type of student is attending the school today than formerly, which may be accounted for by a growing appreciation of the importance of welding and of the future of the welding process.

News From the Field

Large Discount for Cash Increases Cash Business

A job shop in Troy, Ohio, has eliminated much of its bookkeeping and clerical cost and is in a much more liquid position since adopting the rule of allowing a 25% discount on all work if paid for when taken out of the shop. H. L. Bewley, proprietor of the shop, arrived at the figure of 25% by adding the cost of bookkeeping and the losses resulting from slow-paying and dead accounts.

Many concerns who formerly paid monthly upon receiving a statement, now send either a check or cash when the work is picked up. This enables Mr. Bewley to operate his business on less capital and to turn his money over more times per year. Moreover, he can meet current obligations when due and take advantage of cash discounts.

In a city the size of Troy, which has about 9,000 population, the credit problem is made serious by the fact that everybody knows everybody else and therefore it is easy to say, "I'll pay the first of the month." But many don't pay the first of the month, nor the next month, nor the next. The new plan works for Mr. Bewley because he has the courage to look his friend in the face and say, "Discount applies only if you pay when the work is removed, and not two hours later or the next day."

Checks Every New Job With a Straightedge

Welding shops are frequently called on to make repairs on automobile manifolds, cylinder heads, and other parts having straight-edged surfaces. If the surface is warped when the job is brought in, but this is not called to the customer's attention, he may blame the welding shop for the warped surface when the work is delivered.

C. J. Bush, proprietor of the Bush Welding Co., Piqua, Ohio, solves this problem by checking all straight surfaces with a straight-edge as soon as the work is delivered to his shop for repair. If any of the surfaces are out of line, as often they are found to be, he points them out to the deliverer of the work.

Frequently by careful manipulation he can straighten work that has warped and thereby please a customer and at the same time put a few extra nickels into the cash drawer.

Greve Bros., Whitehall, Mich., are remodeling their job welding shop at a cost

of $3000. The new shop will contain three times as much floor space as the old.

Emil Miller, of Manitowoc, Wis., has purchased a 300-ampere General Electric arc-welding unit.

The Twin City Boiler Works, Benton Harbor, Mich., recently purchased a 200-ampere Lincoln motor-driven arc welder.

The Fuller Warren Manufacturing Co., of Milwaukee, Wis., have added a metal-spray unit to their shop equipment.

The Southern Indiana Gas & Electric Co., Evansville, Ind., have installed a 300-ampere Lincoln Stable-Arc welding unit.

F. Lane has moved his place of business, known as the Service Welding Shop, to 302 Washington St., Wapokoneta, Ohio.

The H. E. Bowman Welding Shop, Van Wert, Ohio, recently purchased a new Airco welding and cutting unit complete.

I. L. Stolp, job welding shop proprietor of Valley Junction, Iowa, has added a new Harris welding torch to his shop equipment.

Exner Bros. have moved their job welding and boiler repair shop from 3209 Irving Park Blvd. to 4267 Elston Ave., Chicago, Ill.

The Marathon Electrical Manufacturing Co., Wausau, Wis., has purchased a 200-ampere Hobart motor-generator welding unit.

The C. O. Bartlett & Snow Co., of Cleveland, Ohio, recently completed a contract for some all-arc-welded garbage-disposal tanks.

The Firestone Steel Products Co., Akron, Ohio, are contemplating going into the beer-barrel business, and are reported to be experimenting with a stainless-steel barrel.

Fitzgerald & Hawthorne, owners of a welding and boiler shop at Longview, Texas, have opened a branch shop at Conroe, Texas. The concern features oil-field welding service and general boiler work.

John Bolzer, Jr., operator of a welding shop in Sheboygan, Wis., is doing considerable welding and cutting on the new postoffice building now being constructed in that city. Most of the welding is in connection with the piping installation.

G. F. King, proprietor of the Sidney Welding Works, Sidney, Ohio, states that his shop has just completed 14 welded hydraulic controls and containers for the Slusser-McLean Scraper Co., of the same city.

The Globe Barrel Co., of Cleveland, Ohio, are reported to be manufacturing steel beer barrels, each being made in two sections with an insulating partition between. The temperature of the beer can be better controlled with the insulated barrel, it is claimed.

Robert Kinkead, consulting welding engineer, of Cleveland, Ohio, will give a series of six lectures on "Welding From the Engineer's Point of View" before the American Society for Steel Treating, in Cleveland, beginning in early October and continuing to the first week in December.

When Dougherty Bros., of Cedar Rapids, Iowa, ordered a 300-ampere Hobart electrically driven welding set, they obtained one with a shaft extension. Then, with some Ford Model A parts, they built a portable unit, which allows them to do work outside as well as inside their shop.

Anyone knowing the whereabouts of Ira Scott, a welder, formerly of Worland, Wyoming, is asked to communicate with Charles L. George of that address.

The Munger Welding Co., of Adrian, Mich., has just completed an all-welded smokestack for the Adrian Steam Laundry. The stack is 75 ft. long, 30 in. in diameter, and made of 3/16-in. stock. Each joint is lapped 2 in. and welded solid outside, with intermittent welding used on the inside of the stack.

The Steel Tank & Pipe Co., Portland, Ore., recently completed a drag arm of a new design and greater length on the U. S. engineer's dredge Co. P. S. Michie. The arm is 50 ft. long, 23 ft. high and 6 ft. wide. It is built of ¾-in. flange-steel boiler plate, bent cold and welded, and weighs 80 tons out of the water.

Johnston Bros., boiler and tank manufacturers, of Ferrysburg, Mich., have completed a contract for the Muskegon Brewing Co., of Muskegon, Mich., calling for 40 tanks of various capacities ranging from 75 to 260 barrels. Heavy-coated high-speed electrodes were used.

A new plant employing a great amount of welding in its operation, and which was recently opened in San Francisco, is the Bodinson Machinery Co., at 200 Paul Ave. This company will manufacture various kinds of conveyors, elevating and screening machinery for handling building materials, etc. Fred J. Bodinson is president.

The Groen Manufacturing Co., 4535 Armitage Ave., Chicago, Ill., has gone into the production of a stainless-steel beer barrel, having a mild-steel jacket outside of the stainless steel to absorb the shocks and jars incidental to handling and shipping.

Among welding contracts recently awarded the Southwestern Engineering Corp., of Los Angeles, is one from the Triangle Refining Co., of Venice, Calif., for two large high-pressure heat exchangers, as well as one from the Edington Oil Refining Co., of Signal Hill for a 750-sq. ft. condenser. This equipment is to be of welded construction throughout.

The Waitsburg Welding Works, of Waitsburg, Wash., has completed the fabrication of a welded gasoline tank for the Blue Mountain Grain Growers, of Weston, Ore. Now under way is a second large gasoline plant for the county grange to be erected by this firm at Odessa, Wash., to hold 15,000 gallons, also another at LaCrosse to hold 12,000 gallons.

A contract for the construction of six scows, a total of 2,000 tons, at a cost of approximately $75,000 has been awarded to the Marine Construction Co., Seattle, Wash. The job, largest of its kind placed at a Pacific Northwest yard in many months, calls for completion in ninety days. The scows, which will measure 105x38 ft., are for the Concrete Products Sales Co., of Oakland.

The installation of much new press equipment, welders, enameling booths, etc., at their plant at 1000 West 120th St., Chicago, has enabled the Ingersoll Steel & Disc Co. to get into mass production of their metal beer barrel which they have been recently licensed to produce under a joint agreement with the Krupp Works, of Essen, Germany, and the Ludlum Steel Co., of Watervliet, N. Y.

The Zenith Welding Co., of Wichita, Kan., recently moved from 2117 N. Lawrence to their new location at 413 S. Market St. The shop is operated under the joint partnership of Clifford A. Dobyns and J. Wesley Reece. In addition to general welding of all kinds, they specialize in the manufacture and repairing of factory equipment, and in automotive, farm and oil machinery welding and hardfacing. A new 300-ampere U. S. L. welding unit was recently purchased.

King Bros., Inc., Portland Ore., have the honor of building the only combination light and bell buoys for the federal lighthouse service on the Pacific coast. They recently completed and placed in

service two big bureaus near Astoria, Ore., and due to the excellence of the work will be called on to build others. The buoys are 32 ft. high and have a 4-ton pendulum to keep them upright. The diameter of the float compartment is 9 ft. They are welded construction.

A novel truck with portable arc welder in which the driver's seat is located in a small cab over the rear axle, has been built by Jule Hierholzer for the field work in and around Celina, Ohio. The axle housing and the engine hood extends from the radiator all the way to the cab at the rear, causing the unit to resemble a stackless locomotive. That portion of the hood between the engine and the cab will house the welding generator, which will be driven by a power take-off from the truck engine.

A new Lincoln Shielded-Arc welder of the latest type has been added to the equipment of the Union Iron Works, in Spokane, Wash. Sale and installation were made by George Gibson, Lincoln representative. In the last 18 months Mr. Gibson has placed 18 of these machines in the Inland Empire. With this new equipment the Union Iron Works will fabricate five steel roof trusses for the new building of the American Machine Works in Spokane. Each truss will have a span of 77 ft. and a height of 10 ft. at the apex, and will have welded joints.

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